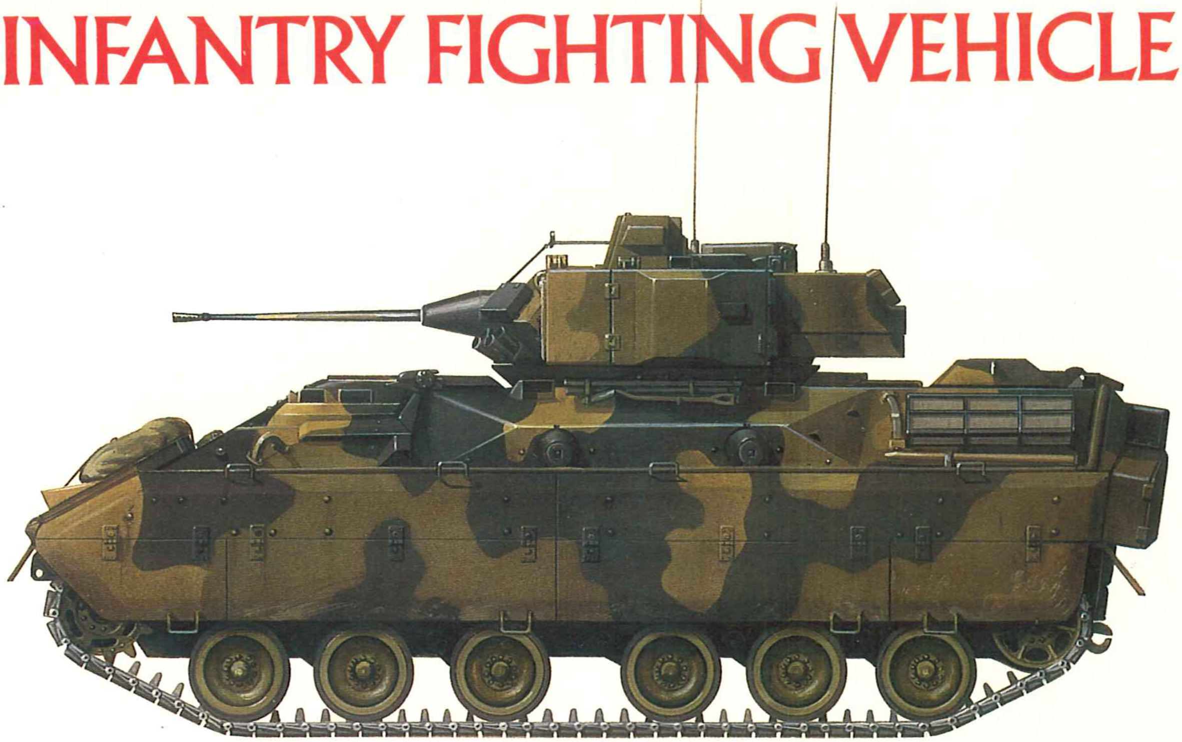
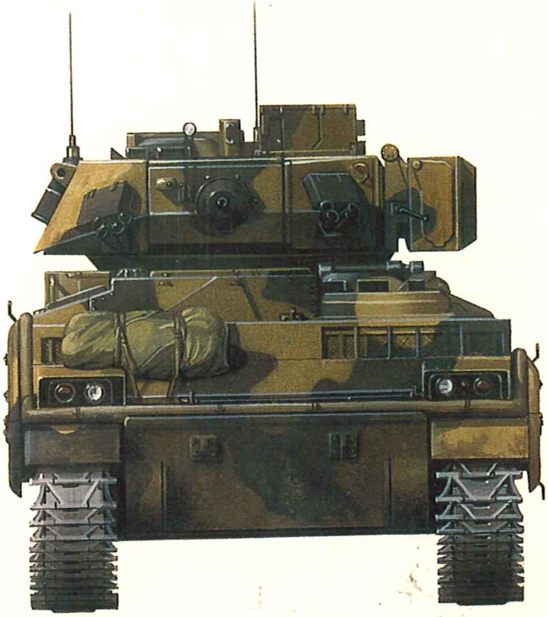
OSPREY · VANGUARD 43

THE M2 BRADLEY INFANTRY FIGHTING VEHICLE





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Michael Trim

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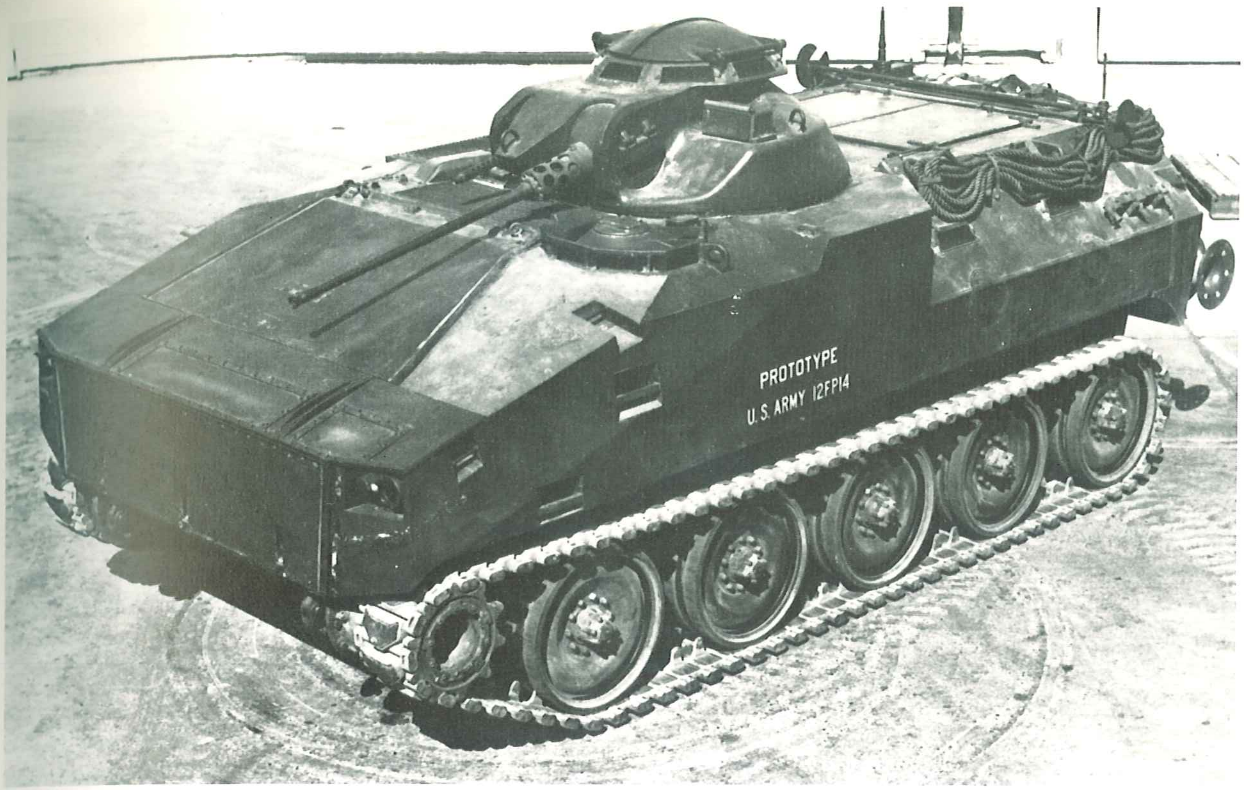

The ill-fated XM701 MICV-65 was the first attempt to develop an infantry combat vehicle for the US Army. It was armed with a 20 mm M139 autocannon, and was provided with firing ports on the hull sides and rear for the infantry squad carried inside. (US Army)

Armoured Infantry

US Army experience with armoured infantry transporters such as the M3 half-track during World War Two helped to clarify the technical requirements for future infantry armoured vehicles. Nevertheless, in the years that followed there was still some debate as to how mechanised infantry tactics should evolve. The general concensus was that the half-track configuration was unacceptable. It offered neither the low cost of wheeled transporters, nor the superior cross-country performance of fully-tracked transporters. The other main drawback of the M3 half-track was that it was open-topped, exposing the infantry squad to overhead artillery airbursts, small-arms fire and grenades. This led to the requirement for a fully-tracked, completely-enclosed replacement, which finally materialised in 1952 as the M75 Armored Personnel Carrier (APC). The M75 arrived too late to see any extensive service in the Korean War, and the concept of a fully-tracked, fully-enclosed infantry vehicle remained untested in combat. Nevertheless, the US Army stuck with the basic configuration in its two subsequent infantry vehicles, the M59 and the famous M113 APC[1].

The M113 APC appeared in 1959 as US Army tactical doctrine was undergoing important re-evaluations. The US Army was beginning to examine whether NATO could realistically expect to withstand a Warsaw Pact attack without recourse to tactical nuclear weapons. American doctrine was placing increasing emphasis on the nuclear option as a counterweight to the greater conventional strength of the Warsaw Pact armies. This had immediate implications for mechanised tactics.

The M113, like its predecessors the M75 and M59 APCs, was envisioned as an armoured 'battlefield taxi'. It would carry its squad to the battlefield, where the infantrymen would dismount from the vehicle to carry out their combat mission on foot. While this had a certain logic on a conventional battlefield, the conception was undermined by the potential presence of nuclear weapons and the related radioactive contamination of the battlefield. American tacticians began to wonder whether a dismounted infantry squad could actually function under these conditions.

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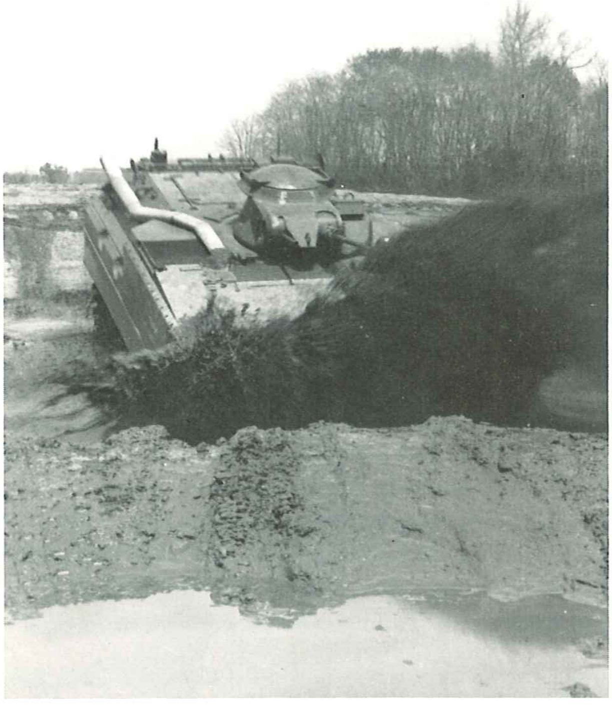
[1] See Vanguard 34, *The M113 Series*; 38, *Mechanised Infantry*; and 42, *Armour of the Vietnam Wars*.

A technical solution to the tactical problem could be provided by having the squad fight from a mounted position in the APC. The APC could be shielded from radiation or chemical contamination, and the squad could fight dismounted if conditions permitted. This also re-opened the issue of whether dismounted mechanised infantry tactics made any sense even on a purely conventional battlefield. Official US Army tactical doctrine in World War Two had held that mechanised infantry (armoured infantry, in American parlance) would always fight dismounted. But some US armoured infantry commanders in World War Two found that mounted actions made more sense under certain circumstances. Unless an objective was heavily protected by anti-armour weapons, a mounted attack offered the advantage of bringing the infantry closer to the objective under protective cover; and, in some circumstances, the squad could fight from the vehicle. Such mechanised attacks could add considerable shock value to the assault. Of course, they also offered the risk of disaster. The infantry squads, bunched up inside each half-track, could readily be wiped out by a single well-placed grenade, or a lucky hit by artillery or mortar fire.

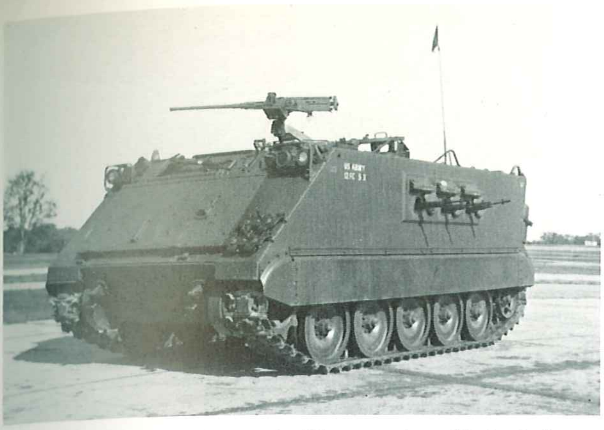


The XM701 MICV-65 during trials at Aberdeen Proving Ground. By 1966 the Army was running out of funds for the programme, and was not very enthusiastic about the XM701 design. (US Army APG)

Infantry Combat Vehicle Genesis

This tactical ferment was being matched in other armies of the time, most notably in the Soviet Union and the Federal Republic of Germany. Development of a new-generation Bundeswehr infantry combat vehicle began in 1959, about the same time as a similar programme in the Soviet Army. The German vehicle emerged ten years later as the Marder; the Soviet vehicle appeared sooner, in 1967, as the BMP. The alacrity with which the Soviet Army adopted this new concept was especially startling given its traditional backwardness in mechanised infantry tactics, and its mediocre record in infantry vehicle development. The Red Army of World War Two was the only major army to completely ignore armoured infantry vehicle development, and its immediate post-war designs—e.g. the BTR-152 and BTR-50—were third-rate. The impetus for change had come from serious political upheavals in the Soviet Army during Khrushchev's reign.

Nikita Khrushchev, faced with a bloated and expensive army and an economy still reeling from the devastation of the war, became convinced that a solution to these problems could be found in nuclear weapons. Khrushchev believed that nuclear weapons made conventional armies obsolete; so he began to make serious cuts in the size of the previously sacrosanct Soviet Army, as well as in the heavy industries budgets which funded new tanks and other Army equipment. This forced the Soviet Army leadership—as well as the Communist Party bureaucracy, which had grown accustomed to its comfortable positions in the favoured heavy industries—out of its Stalinist lethargy. The Army's strategists began to argue that rather than making conventional armies obsolete, the continued de-



As a result of experiences in Vietnam, in 1968 the Infantry School at Ft Benning experimentally adapted an M113 with firing ports to test the infantry combat vehicle notion. This led to the similar XM734, and to further Army efforts at infantry combat vehicles. (US Army)

velopment of nuclear weapons by the US and USSR made total war between the superpowers unthinkable. Therefore, it was possible to envisage a limited conventional war in Central Europe, in which the superpowers would refrain from employing their strategic nuclear weapons against one another. Tactical nuclear weapons were another matter. NATO was obviously putting growing dependence upon tactical nuclear weapons for any possible confrontation on the German plains. Hence, the Soviet Army would have to prepare itself for a confrontation that could involve tactical nuclear exchanges.

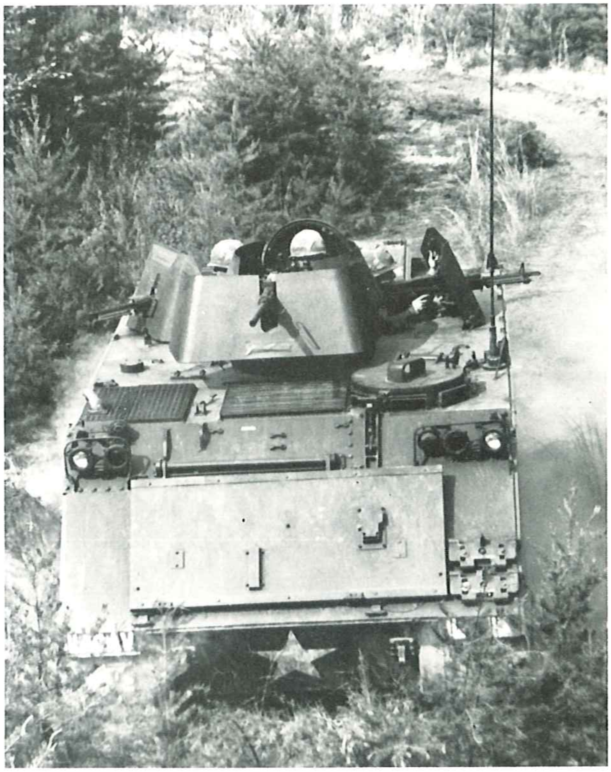
Soviet tacticians and vehicle designers drew the same conclusions as their American and German counterparts. The key sticking point was that dismounted infantry could not survive on a nuclear battlefield. The tactical solution was mounted infantry actions in new vehicles designed for operations on a nuclear battlefield. The technical solution was the BMP. The Soviet Army and the Communist Party's industrial bureaucracy fended off the political threat to their well-being by deposing Khrushchev. But shortly after Khrushchev departed the political scene, the vehicle which his actions had helped into gestation finally appeared in the Soviet Army. The BMP caused a furore in the Soviet Army and in the Party industrial hierarchy. It clearly satisfied the technical and tactical requirements on which it was based: the trouble was, it was hideously expensive. A BMP cost more than a T-62 or T-55 tank. This was unheard of in any army. Army priorities have always been to modernise the tank fleet first, and let the mechanised infantry have the scraps which are left. Although the advent of the T-64 tank at about the same time reoriented the financial balance in the more traditional direction, the BMP caused many officials to question whether its tactical advantages really justified such extravagance.

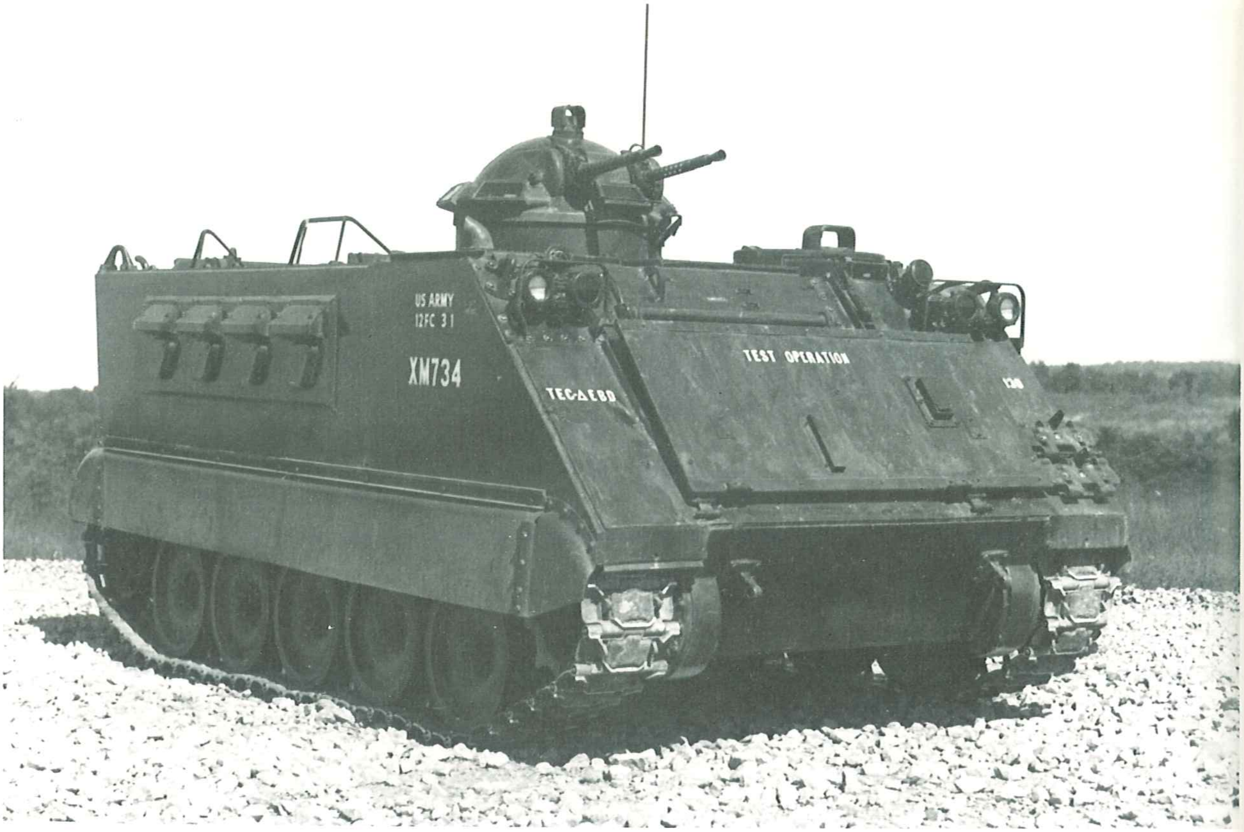
The Soviet experience was repeated in other armies contemplating the same shift away from the relatively cheap 'battlefield taxi' of the M113 generation to the infantry fighting vehicle of the BMP/Marder generation. A typical APC cost about one-seventh to one-tenth the price of a contemporary MBT, but an IFV of the new generation often cost half as much as a tank.

The XM701 MICV-65

The US Army embarked on the same course as the German and Soviet armies. In March 1964 the Army began accepting offers from US industrial

As an expedient solution to the need to protect the crew of M113s firing their weapons outside the vehicle, the M113 ACAV was developed with additional armour shields around roof weapons. This ACAV is undergoing trials with a unit of the 11th Armored Cavalry at Ft Meade shortly before their departure for Vietnam in 1966. (US Army)



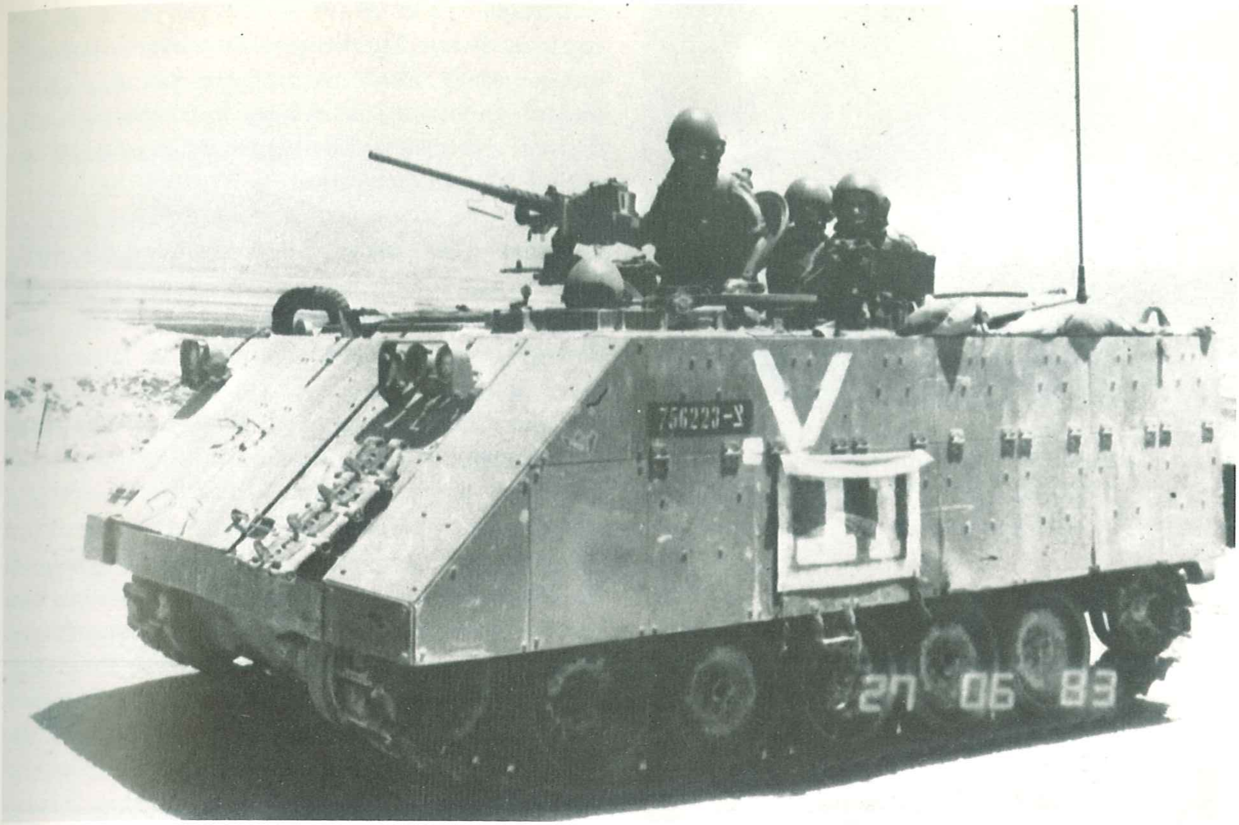


The XM734 was one of the first official US Army efforts to increase the firepower of the M113, while permitting the troops to remain under cover within. It was not felt to be entirely successful, and attempts at more elaborate solutions continued. (US Army APG)

firms for the development of the new MICV-65 (Mechanized Infantry Combat Vehicle-1965). The Army finally selected the bid from Pacific Car and Foundry. The new design, designated the XM701, was based around many components from the M109 and M110 families of self-propelled guns, and testing was completed in 1966. The Army cancelled the programme, arguing that the vehicle was too heavy (26–27 tons), too slow, and that it could not be airlifted in a C-141 aircraft. This was really only part of the problem. In fact, the Army was obliged to cut back on many of its ambitious new development programmes due to the rising cost of the war in Vietnam.

The Vietnam Interlude

The Vietnam War killed the MICV-65 XM701 programme, but also strengthened Army interest in mounted infantry combat. In 1963 US Army advisors began teaching South Vietnamese troops traditional 'battlefield taxi' tactics using their new M113 APCs. The initial combat efforts of the South Vietnamese M113 units were fiascos. The ARVN troops piled out their vehicles, and were chopped up by VC small arms fire. These tactics were dropped in favour of mounted attacks. The VC, and later the NVA, were not particularly well equipped with anti-armour weapons, and mounted actions were often successful. The main problem with the use of the M113 in this fashion was that it had not been designed with such tactics in mind. Only a small portion of the squad could poke their heads out of the roof hatch to use their weapons. In so doing, they exposed themselves to small arms fire. An expedient solution was the M113 ACAV (armoured cavalry vehicle), which had armour shields added around the roof positions to counter small arms fire. There were also some experiments in the USA to modify the M113 by cutting side firing ports in the hull armour to permit the squad members inside to fire their weapons. Notable among these experiments was the XM734, some of which saw limited use in Vietnam. The main problem was that the M113 was not really very well



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The vulnerability of the M113 to RPG-7 rockets and similar weapons has led to various appliqué armour adaptions. This particular configuration, consisting of layered steel armour spaced about a foot from the normal exterior armour, was developed in Israel and used during the fighting in Lebanon in 1982. (Rafael)

There are numerous armament packages available to correct the firepower shortcomings of the M113. The TAT-252 two-man turret developed by Emerson Electric uses the same gun as in the M2 Bradley. However, turret systems inevitably reduce the size of the squad the vehicle can carry. (Emerson Electric)
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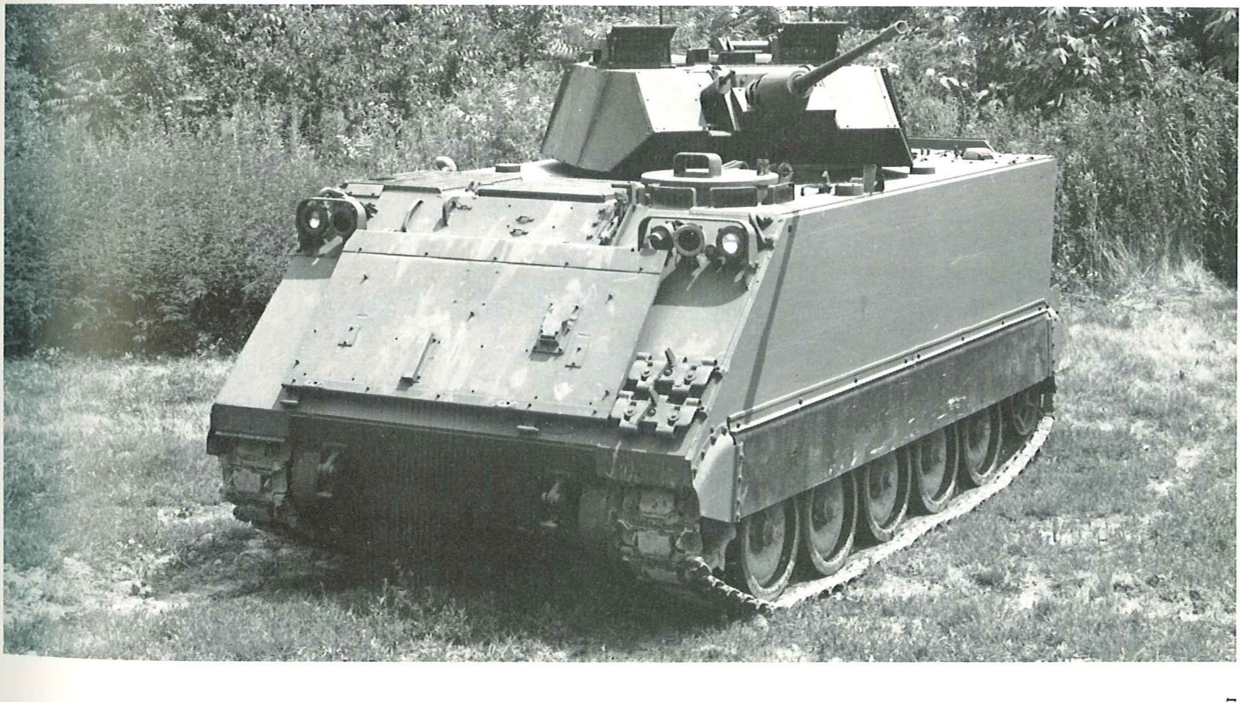
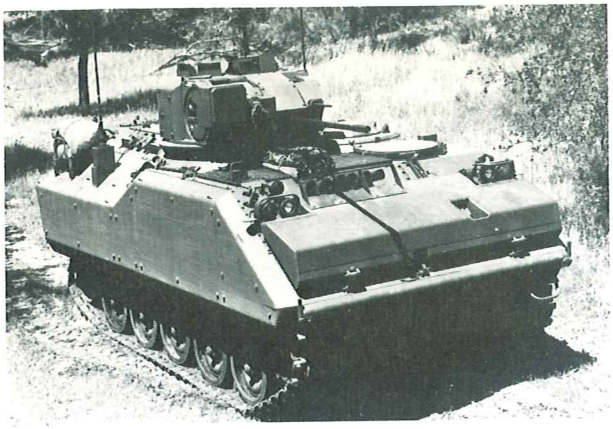




FMC Corp. developed a heavily modernised M113, the XM765, in the late 1960s. Although the US Army was not interested, this vehicle was made available for export, and has been sold to the Dutch, Belgian and Philippine armies. In Dutch service it is called the YPR-765. (FMC Corp.)

configured for this rôle without serious redesign.

If Vietnam experience supported Army interest in mounted infantry tactics, it also drew attention to problems in APC design. All armoured troop transporters built during the 1960s were lightly armoured. This was due to two factors. On the one hand, 'battlefield taxi' tactics meant that such vehicles were not expected to encounter heavy anti-armour threats such as enemy tanks, anti-tank weapons or heavy anti-tank mines. They were only supposed to protect their passengers from overhead artillery airbursts, shrapnel, small arms and other anti-personnel weapons. But when used in mounted operations, they did encounter heavier weapons against which their armour was not proof. An RPG-2 or RPG-7, designed to cut through the heaviest tank armour, could easily penetrate an M113. A more serious threat were large mines. An RPG's damage was usually limited to squad members in the narrow path of the spall cone; this usually meant that casualties were limited, unless a major internal fire or explosion was caused. In contrast, a large mine, designed to destroy a heavily armoured tank, could kill most of the squad inside an M113. Not surprisingly, many squads took to riding on the outside of their M113s, fearing the all-too-common mine more than small arms fire.

Conditions in Vietnam were not identical to those in Central Europe. Mines were by far the greatest threat to armoured vehicles in Vietnam, while in a Central European environment direct-fire anti-armour weapons would play a much greater part. The M113 saw service again in the 1973 war in the Middle East with Israeli forces. It was generally liked, earning the popular name 'Zelda', but Israeli mechanised infantrymen also showed a propensity to ride on the outside of the vehicle in many situations.

The Tribulations of the 'Armoured Grunt'

The seemingly irrational desire to avoid the protection offered inside the M113 points to a major flaw in the 'battlefield taxi' concept. It ignores the psychological elements of mechanised infantry combat. APCs are not particularly comfortable to ride in, even in peacetime: a squad of ten men is crammed into a space that is hardly the size of a small bathroom. It is too low for them to stand except at a crouch, and if the APC is fully manned the troops are packed so close together that they can hardly move their arms. Besides the infantrymen themselves, the insides are littered with their gear and weapons. In cross-country travel an APC offers a very jarring ride, aggravated by the fact that the occupants cannot see the terrain they are traversing, and so cannot anticipate jolts from terrain obstructions and ditches. APCs become unbearably hot in temperatures much above 75° F. When the hatches are all closed, there is only the pallid illumination of a small dome light, and the ventilation of a single fan.

The combination of cramped conditions, heat, diesel fumes, gloomy lighting, the confined stench of a squad of infantrymen in prolonged field conditions, and the nausea of a bouncing ride create a peculiar sort of claustrophobia. This mental tension only serves to worsen the infantryman's normal combat fears. Confined in a nauseating steel box, the soldier cannot see what fate awaits him outside—but he can hear the horrifying noise of battle over the din of a racing engine and the piercing creaks of the APC's tracks and suspension. A soldier who has seen combat knows what happens to the crew of an APC that runs over an anti-tank mine: the APC's armour confines the mutilating blast of the mine inside its shell. Other threats are no less pleasant. Although an RPG might not wipe out a whole squad, an RPG hit throws a narrow spray of superheated gas and hypervelocity metal shards into the vehicle. An infantryman sits with his back to the outside wall of the APC, where any moment the fiery tongue of an RPG hit could enter. Even worse fates can be imagined should a tank fire on an APC with its main gun. A modern tank gun and some modern anti-tank guided missiles can ream out an APC with horrific effects.

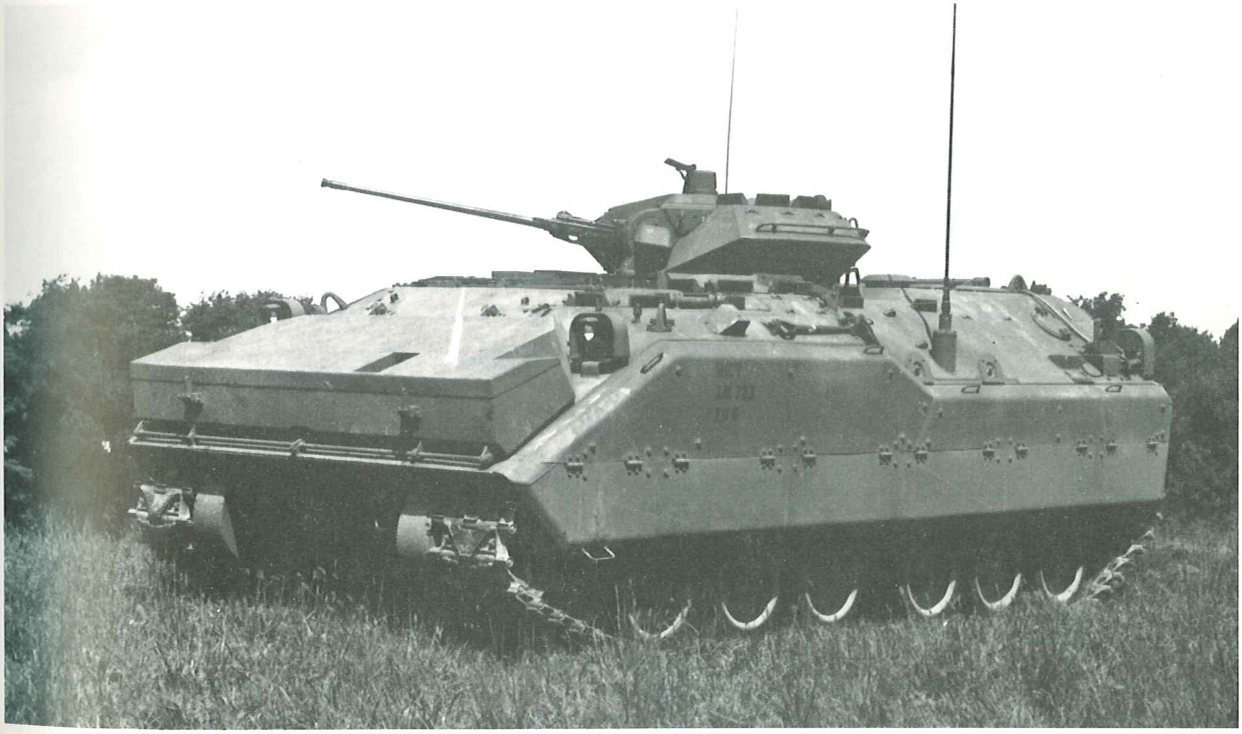
Not surprisingly, many infantrymen in combat would rather ride on the outside of an APC than inside, even if the inside offers them protection against small arms, machine guns, artillery blasts and many other threats. With a head outside the confines of the APC, the claustrophobia is relieved: anxieties subside; horribly exaggerated fears shrink with a view of the battlefield. Very few battlefields are as horrible in reality as the imaginings of a frightened and anxious mind.

Most APCs have been designed against the objective threats of anti-personnel weapons; they have ignored the subjective threats to the morale of mechanised infantry posed by their armoured enclosure.

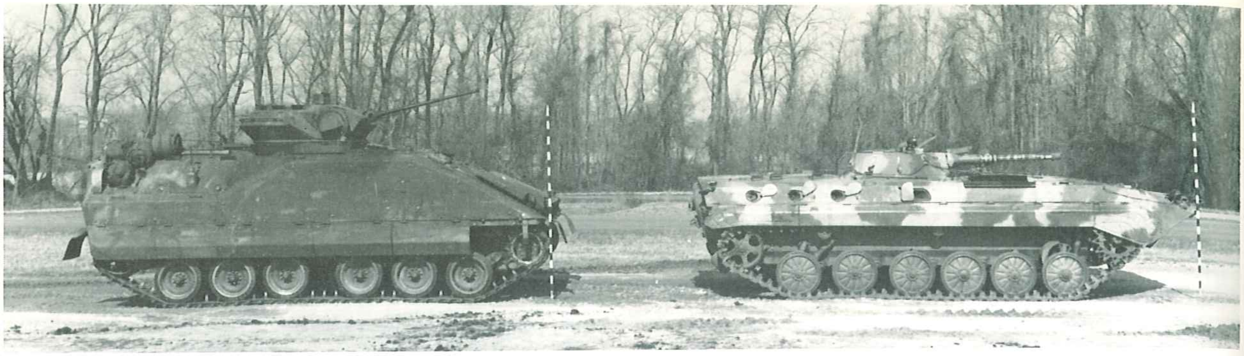
There was growing recognition of this fact by armoured vehicle designers in the late 1960s. A technical solution to the problem was to offer the enclosed crew a view outside the vehicle. This could relieve their anxieties, and partially compensate for some of the other problems of riding in an armoured vehicle. Moreover, such a feature coincided with the tactical requirements for a new generation of infantry combat vehicles which mandated firing ports to permit the infantry to fire their weapons from within the protected confines of the vehicle.

The MICV again?

In 1968 the Army formed a special task force headed by Maj. Gen. George Casey to re-examine whether an MICV was really needed. The Casey task force emphatically urged that the Army continue the development of an MICV. The task force pointed out not only that such a vehicle was necessary in order to permit infantry squads to operate in a contaminated environment or on a conventional battlefield, but also that important changes were occurring in Soviet infantry formations which mandated such a vehicle. The BMP had begun to appear; but this was only one small aspect of a dramatic Soviet Army programme to modernise its infantry. Besides the small numbers of expensive BMPs being introduced, the Soviets were



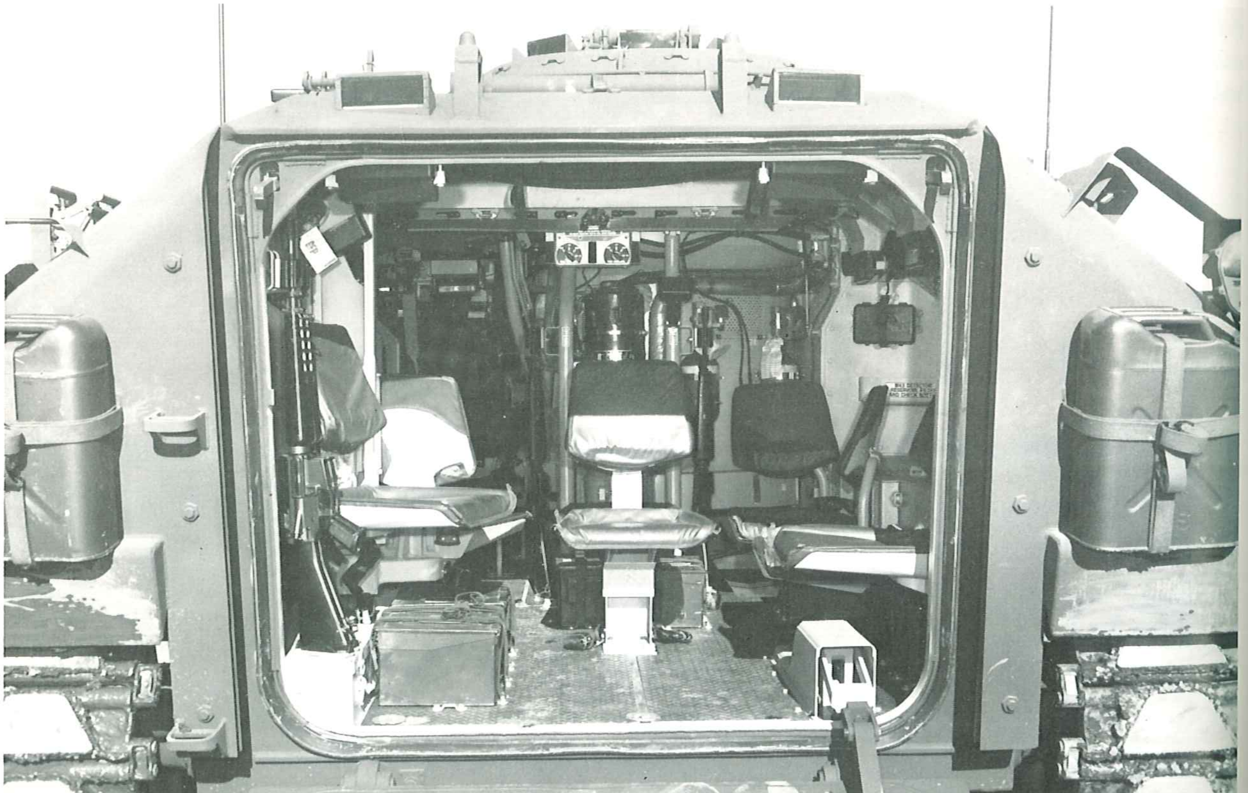
Although closely resembling the XM765, the new XM723 MICV was larger, more heavily armoured and more mobile. The XM723 was fitted with a one-man turret armed with a 20 mm M139 autocannon. Plans were under way to mount a 25 mm gun, but these were cancelled when it was decided to go for a two-man turret. (US Army APG)



US infantry vehicles are normally higher than comparable Soviet vehicles, as is very evident in this view showing the XM723 next to a Soviet BMP-1. The height difference is due to US preference for a vehicle large enough to accommodate infantrymen up to six feet tall; by comparison, the Soviet vehicle's troop compartment is incredibly cramped. The XM723 MICV had the same layout as the Soviet BMP, with the squad leader behind the driver. This isolated him from much of the squad, and did not provide him with a good view of the battlefield. (US Army APG)

also producing much greater numbers of the new BTR-60PB. The BTR-60PB was armed with a 14.5 mm cannon capable of penetrating the armour of the M113. The introduction of the BMP and BTR-60PB marked the beginning of a programme by the Soviet Army to do away with conventional infantry in favour of a fully mechanised army. The US Army was being faced with the prospect that soon all Soviet divisions would be heavily equipped with both tanks and armoured troop transporters capable of destroying the M113. The M113 was not well enough armed to threaten any of these vehicles. As a result, a new MICV project manager's office was opened in 1968.

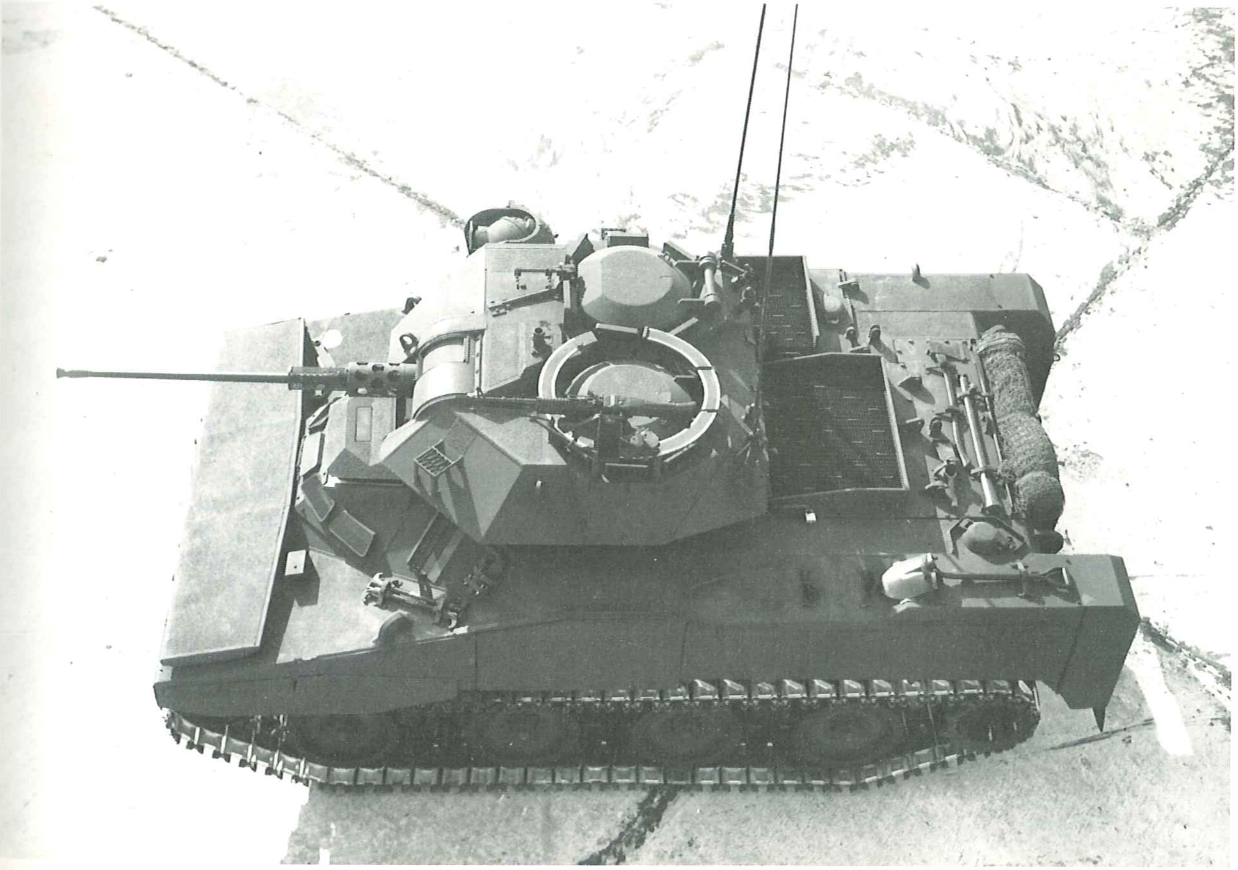
The troop compartment in the XM723 could accommodate a nine-man rifle squad besides the two vehicle crewmen. (FMC Corp.)



FMC Corporation had been one of three bidders on the MICV-65 programme, but had lost the competition. FMC was still building the M113 at the time, but realised that the future of the APC business was moving in the direction of new generation infantry fighting vehicles. Using its own funds, it redesigned the M113 as an IFV, and tried to interest the Army in it. In 1969 and 1970 the MICV Office examined this possibility, as well as considering whether the US Army might adopt the German Marder to satisfy its MICV requirement. The FMC vehicle, the XM765 AIFV, was rejected by the Army, which was in the midst of preparing designs for a new generation tank that would emerge later in the 1970s as the M1 Abrams[1]. A primary feature of this tank was to be high cross-country speed. This was desired not only for improved mobility, but as a form of passive protection. Tests had shown that armoured vehicles moving cross-country were much harder targets for enemy tank guns or anti-tank missiles. Since the new infantry fighting vehicle would serve in conjunction with the M1, high speed would also be required of it. Also, with the advent of the Soviet BTR-60PB, the requirement for the armour protection of the new vehicle increased. The Marder was also rejected, on the basis of cost and armour protection.

As a result, in November 1972, the Army awarded FMC Corp. a contract to develop a vehicle similar to the AIFV, but faster and better armoured. This vehicle was the XM723 MICV (Mechanized Infantry Combat Vehicle). The MICV closely resembled the AIFV, but was based on heavier components derived from the LVTP-7 Marine Corps amtrac rather than the lighter M113. The technical requirements for the vehicle were not particularly exotic. The MICV was to be armed with a 20 mm gun in a small one-man turret, with firing ports for its nine-man squad. It was to be

The XM800-T ARSV proved to be a technically successful scout tank design, but was killed due to Army recognition that Congress was unlikely to fund it. Its cancellation led to the combining of the ARSV and MICV requirements, forcing another redesign of the vehicle. The XM800-T turret closely resembles the turret eventually adopted for the IFV/CFV. (US Army APG)



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[1] See Vanguard 41, *The M1 Abrams Battle Tank*.

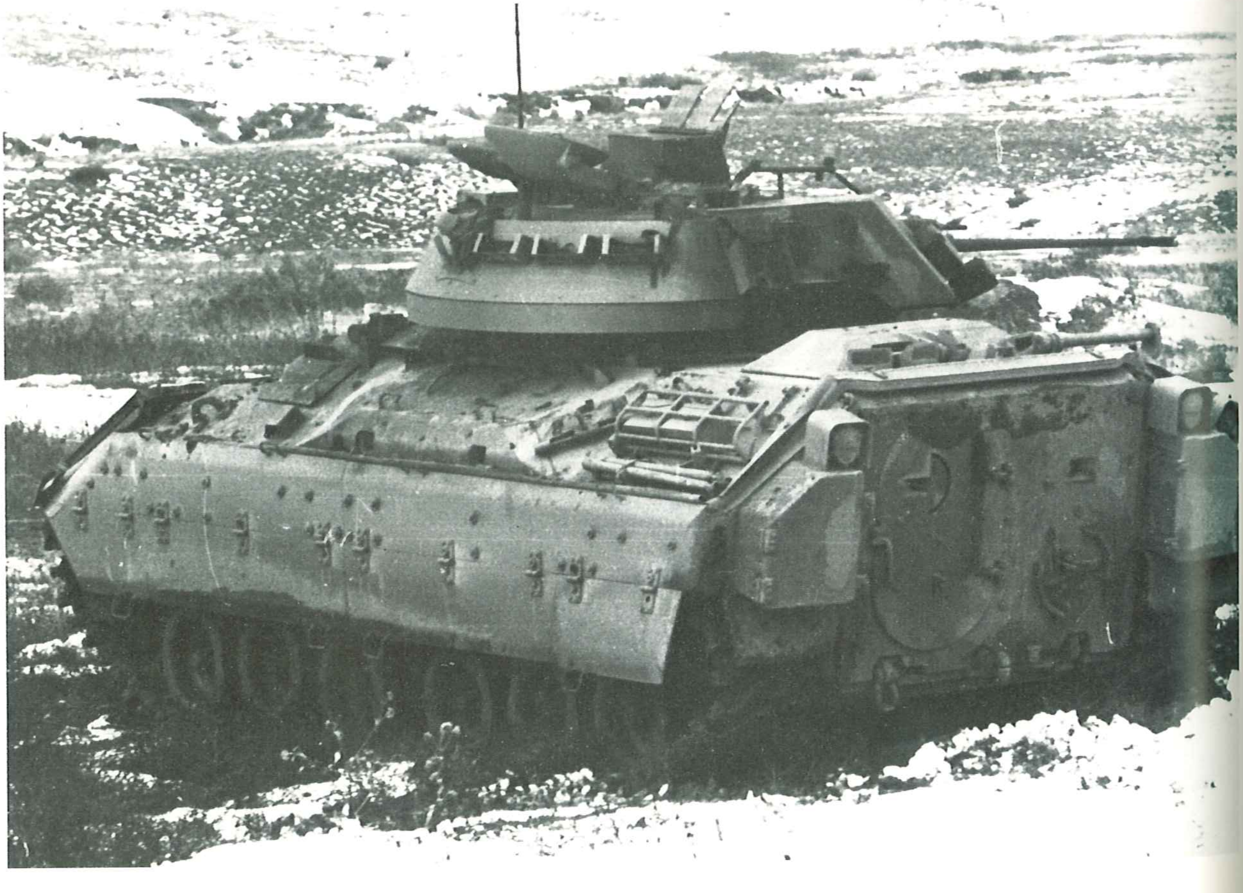
protected by a novel laminated steel/aluminium armour developed by FMC, which was relatively light in weight but offered improved protection against small projectiles of up to 14.5 mm calibre. It was capable of speeds up to 45 mph.

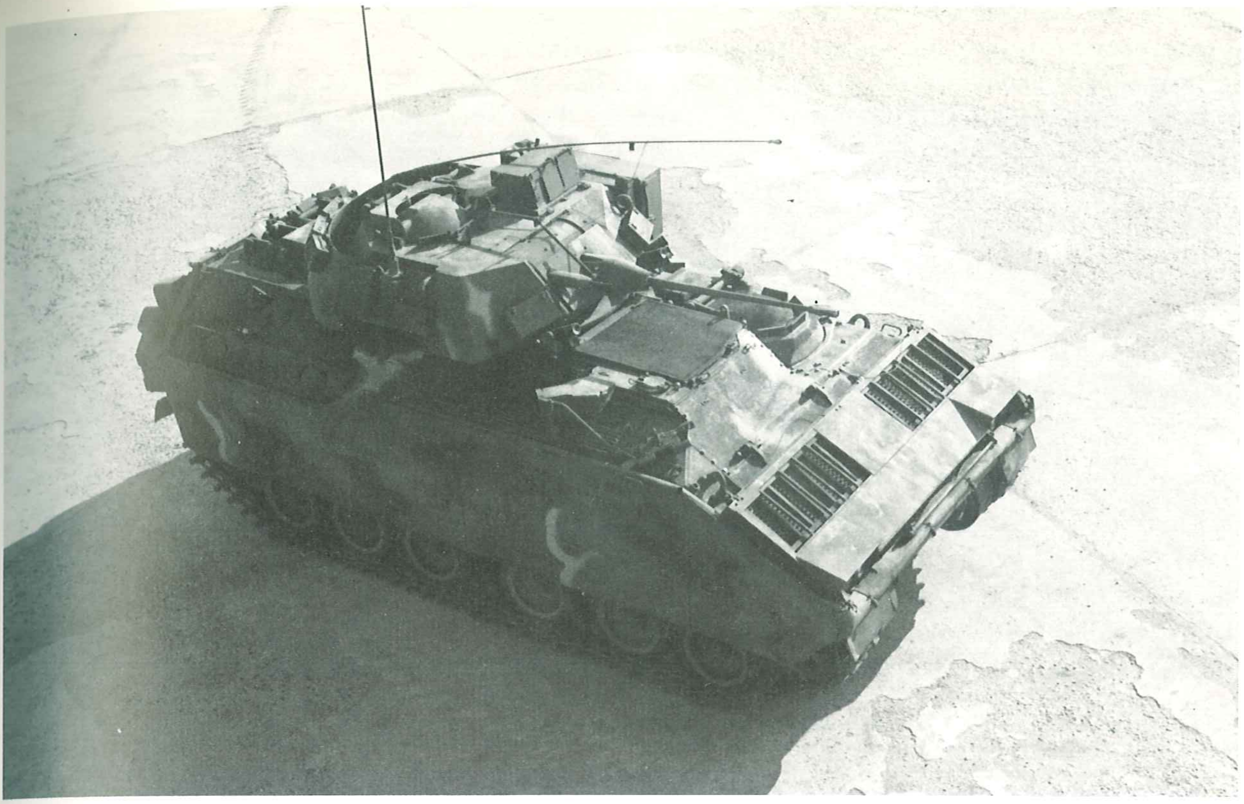
Although the technical requirements for the new MICV were not overly complicated, its fate soon became entangled with other programmes that would eventually drag out its gestation. The VRFWS-S was a new Army gun programme engaged in developing an externally powered autocannon. These differ from conventionally gas-operated machine guns or autocannons in that their firing cycles are independent of bleed-off gas from the projectile propellant. Their main advantage is that they are not easily jammed, since a misfired round is automatically expelled rather than requiring manual removal, as is the case with more conventional gas-operated weapons. This weapon was envisioned for use on light armoured vehicles like the MICV, on helicopters and in a new air defence gun. Problems in the development of this weapon forced the Army to consider using the older M139 20 mm cannon in lieu of the VRFWS-S. However, these guns differed considerably, forcing time-consuming changes in turret configuration.

The redesigned XM723 MICV emerged in 1978 as the XM2 IFV. This is one of the eight prototypes undergoing winter trials. The prototypes can be readily distinguished from the standard production models by the different configuration of the firing port housings on either hull side. (Hughes Helicopter)

The ARSV entanglement

Far more troublesome was the interference of the ARSV. The XM800 ARSV programme originated in October 1971, when Lockheed and FMC were given competitive development contracts for the design of a new Armoured Reconnaissance Scout Vehicle. This was intended to replace the troubled M114 and M551 cavalry scout vehicles. The government tests of both vehicles took place beginning in November 1973. The tests of FMC's XM800-T tracked ARSV were particularly successful. However, the programme was brought under fire by US Army Training and Doctrine Command (TRADOC) and other elements of the Army. The





The production model of the M2 Bradley IFV emerged in 1980–81. Its appearance compared to the XM723 was considerably altered by the larger turret. (US Army APG)

programme was not challenged on the grounds of the technical requirements of the design, nor on the basis of the need for a new scout vehicle. Rather, the Army was coming to realise that in the wake of Vietnam, the Congress was not very enthusiastic about funding a host of new Army programmes. In the early 1970s the Army had a collection of new programmes which had been postponed or cancelled due to the costs of the Vietnam involvement. There were requirements for a new helicopter to replace the UH-1 Huey; a new attack helicopter to replace the AH-1 Cobra and cancelled AH-56 Cheyenne; a new main battle tank to replace the M60 and cancelled MBT-70; a new armoured infantry vehicle to replace the M113 and the cancelled XM701 MICV-65; a new mobile air defence gun to replace the interim M163 Vulcan; and a new mobile air defence missile vehicle to replace the interim M48 Chaparral system. All this added up to really big bucks. The situation was not helped by the anti-military mood in Congress over the recent Vietnam involvement, and this mood was further worsened by the widespread perception in Congress that many of the Army's weapons designs in the 1960s had been a bit too gold-plated and complicated.

The cancellation of the XM800 ARSV programme in November 1974 was indicative of an Army recognition of the political and fiscal realities of future Army budgets in Congress. Early in 1975, steps began to be taken to merge the ARSV requirement into the MICV programme. TRADOC began examining whether the MICV as currently configured could satisfy the ARSV requirement. The general conclusion was that a scout vehicle would need some anti-tank capability, and that a two-man turret would be more desirable than a one-man turret as on the XM723, since it would allow the second crewman to act as an observer. As the ARSV requirement was being examined, US Army intelligence was beginning to pick up signs of major policy debates in the Soviet Army over the BMP. These became manifest on the pages of the Soviet Army journal *Voenniy Vestnik*. These debates were believed to have been prompted by a poor showing of the BMP in the 1973 war between Syria and Israel. US analysts assumed that the poor showing had prompted the Soviet Army to question the concept of an infantry fighting vehicle like the BMP. In fact, the debate grew from continuing controversy within the Soviet Army over the high cost of the BMP, as well as from concern that the BMP was not as well suited to a non-nuclear battlefield as to a nuclear one. The Soviets had paid little attention to the Syrian experiences with the BMP, due to a disparaging view of the Syrians' martial talents. (Only about 50 BMPs had been used in 1973, and about half the losses were due to the vehicles being abandoned by their crews.)

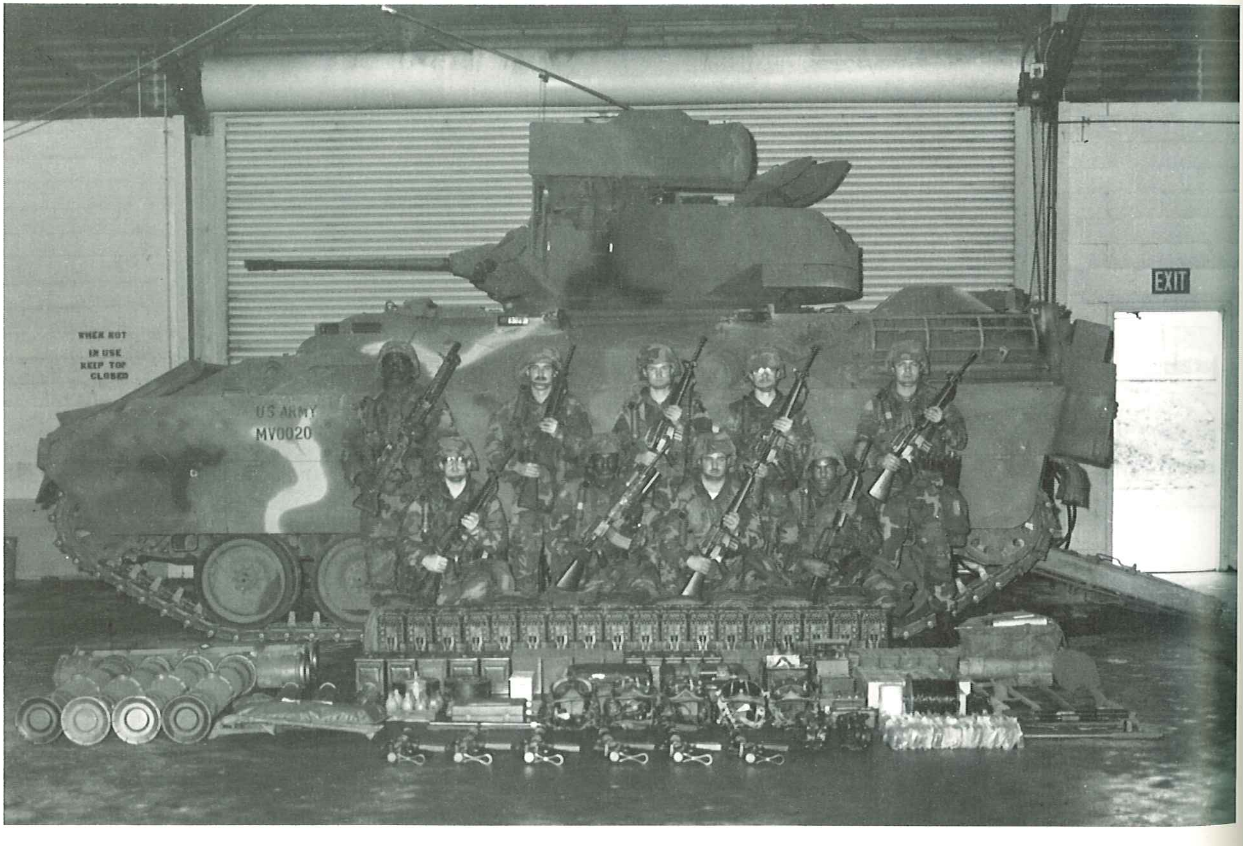
Nevertheless, American perceptions of the Soviet controversy prompted the Secretary of the Army to challenge the basic MICV concept. This resulted in the establishment of yet another special task force, this time headed by Brig. Gen. Larkin. The Larkin Task Force examined three issues: Was the XM723 the right vehicle, or were foreign alternatives more suitable? Was the basic notion of an MICV sound? How could the MICV and ARSV requirements best be harmonised into a single vehicle?

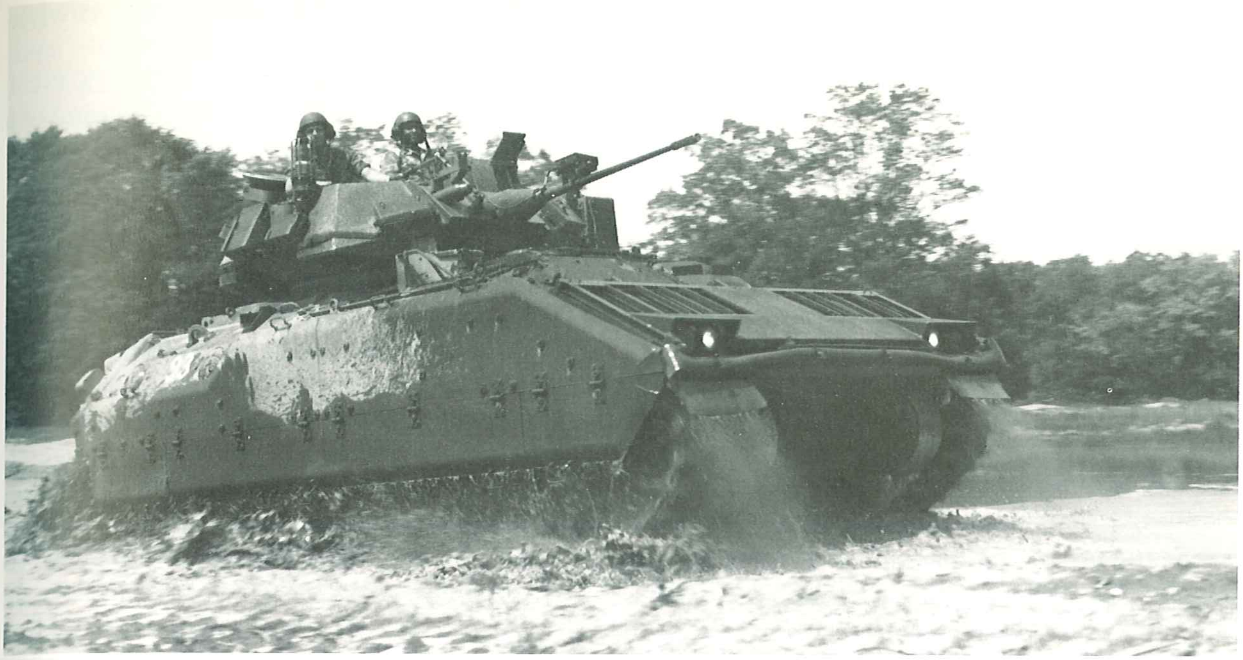
The Army again examined foreign alternatives to see if they would be more cost-effective. The Marder was very popular with US Army officers familiar with it from tours of duty in Germany. However, as in the case of the first task force, it was turned down due to its high cost, its heavy weight and lack of amphibious capabilities, its relatively light armour, and its armament system. The MICV requirement called for protection against at least 14.5 mm cannons like that on the BTR-60PB, and the preferred armament solution was a heavier gun with full stabilisation to permit firing while on the move. The French AMX-10 was also examined and rejected, and the task force examined some BMP-1s captured by the Israelis from the Syrians.

Heavy infantry vehicles?

The task force concurred with the general sentiments of the BMP advocates in *Voenniy Vestnik*. Although the BMP (or MICV) was not adequately armoured to protect it against all anti-tank

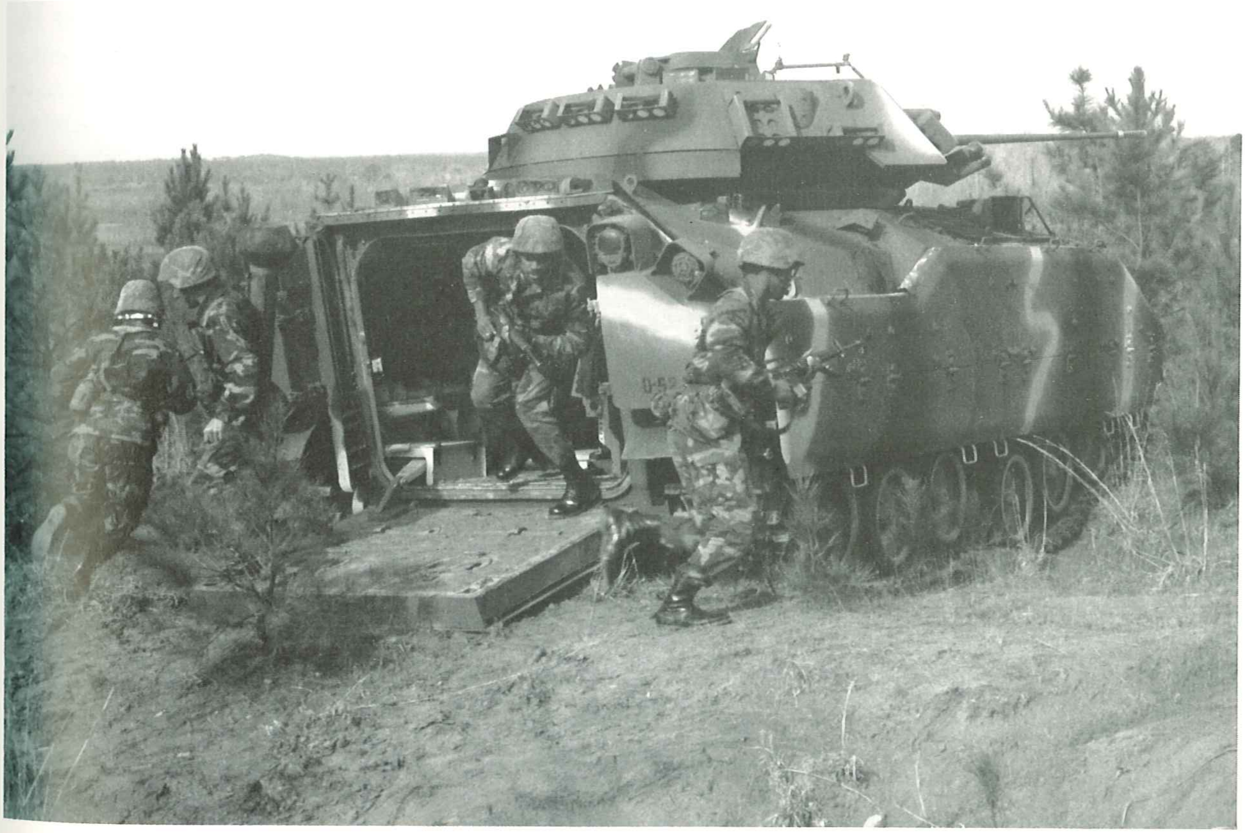
The size of the Bradley is heavily dependent on what must fit inside. This photo dramatically illustrates why it is so large. This shows a full vehicle crew, plus all the expendable munitions and separate tools that are carried inside. (US Army APG)





▲ An M2 Bradley undergoing production lot testing at APG. Even after a US vehicle is accepted for Army use, production vehicles are rigorously tested to make certain that engineering corrections work as planned. This particular Bradley is fitted with the MILES laser engagement training system on the turret. (US Army APG)

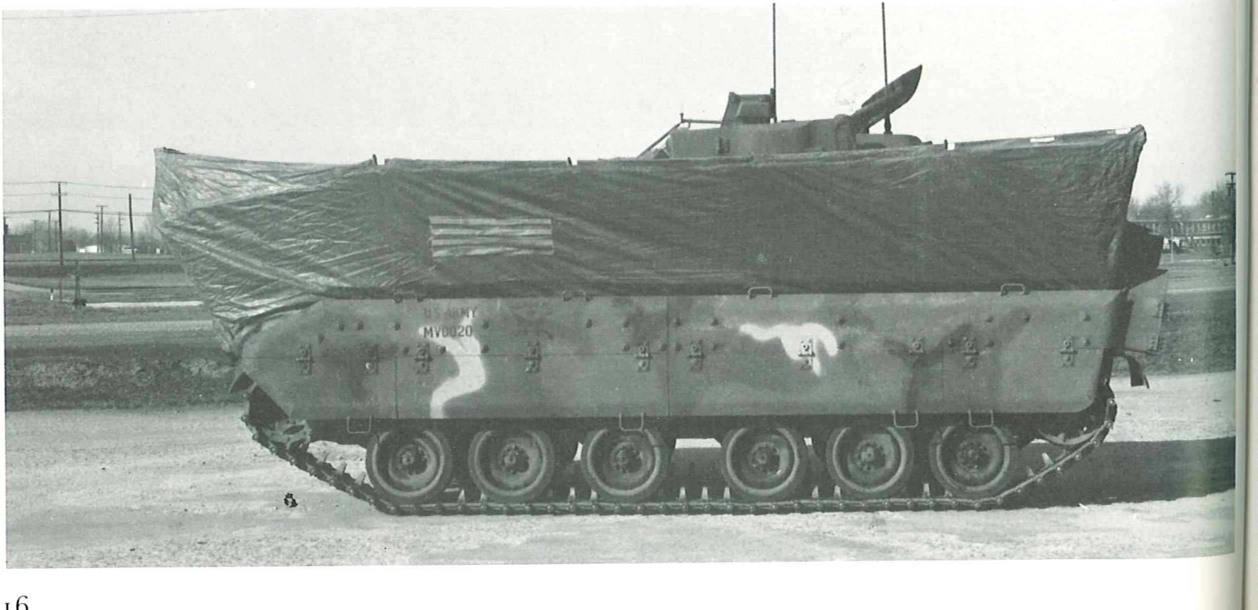
A rifle squad of the 197th Infantry Brigade disembark from a Bradley. The Bradley is armed with an M242 25 mm automatic cannon. This particular weapon, built by Hughes Helicopter, is also used on the Marine Corps Light Armored Vehicle (LAV), on aircraft and on ship mountings. (Hughes Helicopter) ▼



weapons like tank guns or anti-tank missiles, its tactical employment would minimise exposure to such weapons. The task force realised that this was not an ideal solution: inevitably, MICVs would encounter such weapons on the battlefield. But realistically, there were no alternatives. As the result of pressure in the Army from advocates of an MICV as heavily armoured as a tank, a separate study was conducted of the 'Tank Infantry Vehicle' notion. The conclusion was that even if refurbished M48 hulls were used, such a vehicle would cost twice as much as the MICV. Furthermore, since there were not enough M48 hulls to satisfy the MICV requirement, production of new hulls would add costs beyond this for further vehicles.

This conclusion was hardly unique to the US Army. No army to date has adopted an armoured infantry transporter as heavily armoured as a tank except on an expedient basis. In World War Two the British Army used 'Ram Kangaroos' based on obsolete Ram tank hulls; and the Israelis have made limited use of small numbers of Centurion hulls. The problem is quite simply that such vehicles are too expensive. The cost of the added armour is not the main problem: but added armour means extra weight, thereby requiring a more powerful (and expensive) engine, transmission, suspension and other components. Heavier vehicles place greater wear on tracks and other components. A heavy infantry vehicle not only costs twice as much as an MICV, but its lifetime support costs are considerably higher. US sources estimate that the lifetime costs of an armoured vehicle the weight of a tank are four times the basic purchase price over a 20-year period due to the higher level of wear on the powertrain and suspension. Light armoured vehicles do not have such a high lifetime cost relative to their purchase price due to the lesser strain they place on running gear and engines. Most armies buy more armoured infantry transporters than tanks, and none has been able so far to enjoy the luxury of a heavy infantry vehicle. Besides the cost problems, there are tactical drawbacks as well. A heavy infantry vehicle cannot be made amphibious, requiring an army to expand its stockpile of tactical bridging for river crossing operations. For the US Army weight is a serious drawback, since in an emergency vehicles have to be shipped or airlifted great distances.

There is no happy middle ground in this controversy. On the modern battlefield, weapons tend to be lumped into two categories. Anti-personnel weapons are the most numerous, and they can be countered by light armour as on the MICV. At the other end of the spectrum are the anti-armour weapons. Even relatively small weapons like the RPG-7 have phenomenal armour penetration capabilities. The RPG-7 can penetrate 13 inches of steel, and more modern types can literally penetrate 16 inches of battleship armour. Of course, the amount of damage caused inside the



The Bradley is amphibious once the swimming skirt is raised. This is normally stowed in a folded position in a recess along the hull sides and front. (US Army APG)

armoured vehicle is somewhat more limited. Tank guns using depleted uranium kinetic energy penetrators can not only penetrate such armour, but can cause massive damage inside an armoured vehicle as well. Due to the nature of ground weapons, armour configurations are either on the light side, to defend against anti-personnel weapons, or extremely heavy, to defend against anti-tank weapons. There is no sense in adopting an armour level in between.

In November 1976 the Larkin Task Force made its recommendations. They supported the MICV concept, as well as the case for merging the MICV and the ARSV requirements. However, they supported the cavalry advocates, who urged the adoption of a two-man turret, armed with an additional TOW launcher for added anti-armour capability. They made it clear to the Secretary of the Army that there was no realistic alternative to the concept, either in the form of a heavy infantry vehicle or a reversion to the M113.

Yet another bend in the road

The Secretary of the Army formally approved the recommendations of the Larkin Task Force later in the month, and ordered the award of a contract to FMC Corp. to develop the XM723 MICV into the new vehicle. It was designated the XM2 Infantry Fighting Vehicle (IFV) to supplant the MICV, and the XM3 Cavalry Fighting Vehicle (CFV) to satisfy the ARSV requirement. Originally, the Army had planned to begin acquiring the XM723 MICV with the interim 20 mm M139 gun in 1978, but with the re-orientation of the programme, these plans were delayed. Congress reacted to the constant turmoil in the programme by a 1977 law obliging the Army to begin production of the new infantry vehicle no later than 1981.

Not unexpectedly, the XM2/XM3 Fighting Vehicle System (FVS) proceeded relatively smoothly. Problems with the transmission on the XM723 led to a competitive development programme, with General Electric receiving the nod in June 1977. The decision to adopt a two-man turret caused some controversy in the infantry. The two-man turret inevitably cut into the size of the squad that could be carried, lowering the total crew size from 11 to nine, and the squad size from nine to seven. In spite of the controversy, this has been a blessing in disguise. The XM723 used a crew layout patterned on the BMP, with the squad leader occupying a forward position behind the driver and isolated from his squad. In this location, the squad leader does not have the panoramic view available in a turret position. Test crews from Army test installations with whom the author spoke were very uneasy about this configuration. The squad leader placed in the turret becomes less isolated from his squad, and has excellent views in all directions. The added twin TOW anti-tank missile launcher subsequently won the enthusiastic endorsement of

A Bradley during swimming trials in the Chesapeake River. Propulsion in the water is provided by the tracks. (US Army APG)

the infantry units who began receiving the M2 in 1982. The number of armoured vehicles in Soviet divisions continues to rise, and the TOW launcher gives the infantry squads the feeling that they are not helpless if confronted by heavy armour—as is unfortunately the case with the M113.

The Bradley Finally Arrives

The initial eight prototypes were delivered for testing in 1978. The tests proceeded without any major difficulties and, indeed, the XM2 even exceeded some of its requirements. The Army Systems Review Council gave its nod of approval in December 1979 in the wake of the tests, and this was followed in January 1980 by production approval from the Secretary of Defense. The IFV/CFV was the first Army tracked combat vehicle in 20 years to meet all its requirements and to be approved for production by both the Army and the Secretary of Defense the first time around. Following type classification, they became the M2 IFV and M3 CFV. Although there were originally plans to name the M2 after Gen. Omar Bradley, and the M3 after Gen. Jacob Devers, the two famous World War Two commanders, it was eventually decided to name them both after Gen. Bradley due to the basic similarity of the vehicles. The US Army is overly fond of acronyms, and so the IFV and CFV received a collective acronym, the BFV (Bradley Fighting Vehicle), which shows up regularly in official Army descriptions of the vehicle.

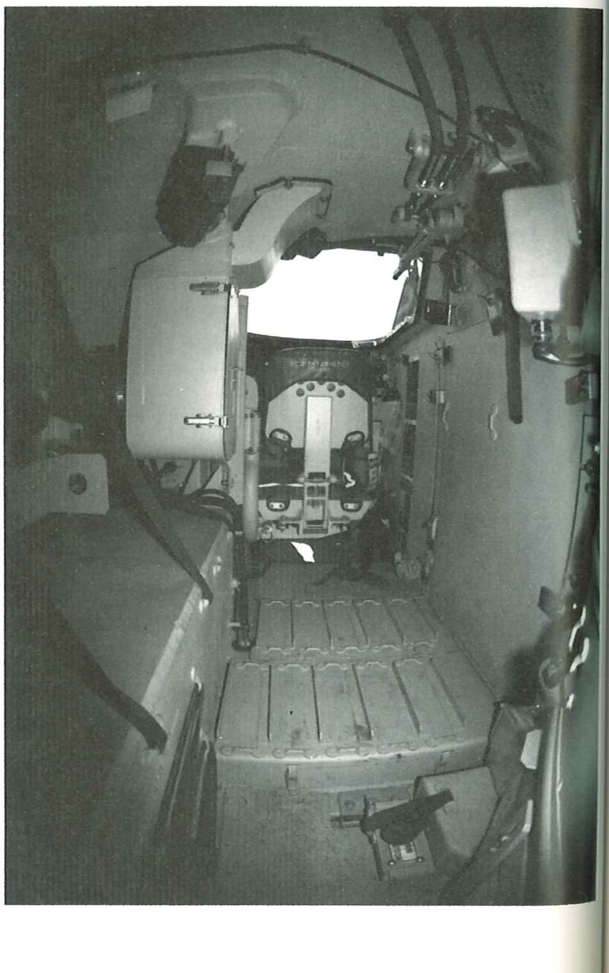
Funding for the first one hundred Bradleys was provided in the Fiscal Year (FY) 1980 budget, consisting of 75 M2 IFV and 25 M3 CFV. This was followed by 400 more in FY81, 600 annually through 1984 and 680 in FY85. By 1982 enough had been produced to begin equipping mechanised infantry units, with the 41st Infantry, 2nd Armored Division at Ft Hood being the first unit so equipped. The first unit to begin receiving the Bradley in Europe in 1983 was the 3rd (Mechanized) Infantry Division.

Trial by pen

Although the Bradley had passed its technical and operational tests without difficulty, it was subjected to the now-familiar Press bashing in 1983 and 1984. A wide variety of charges were directed at the programme. Many of the criticisms were simple-minded. For example, some critics charged that the Bradley was too high, especially when compared to the Soviet BMP. Some of the same critics also complained that the troop compartment was too cramped. That these criticisms should be mutually exclusive does not seem to have occurred to the critics. The height of the vehicle is determined in part by the presence of the turret, and in part by the design of the vehicle to accommodate over 90 per cent of the range of physical builds found among US soldiers. The Bradley is designed so that troops over 6 ft tall can sit inside, while the BMP is designed for shorter men.

Not surprisingly, the Bradley came under fire for its cost. In 1984 dollars, the basic M2 IFV cost $1.1

A view down the 'crawl space', looking towards the driver's station. Two squad members are stationed in this area when the M2 is fully crewed. (Author)

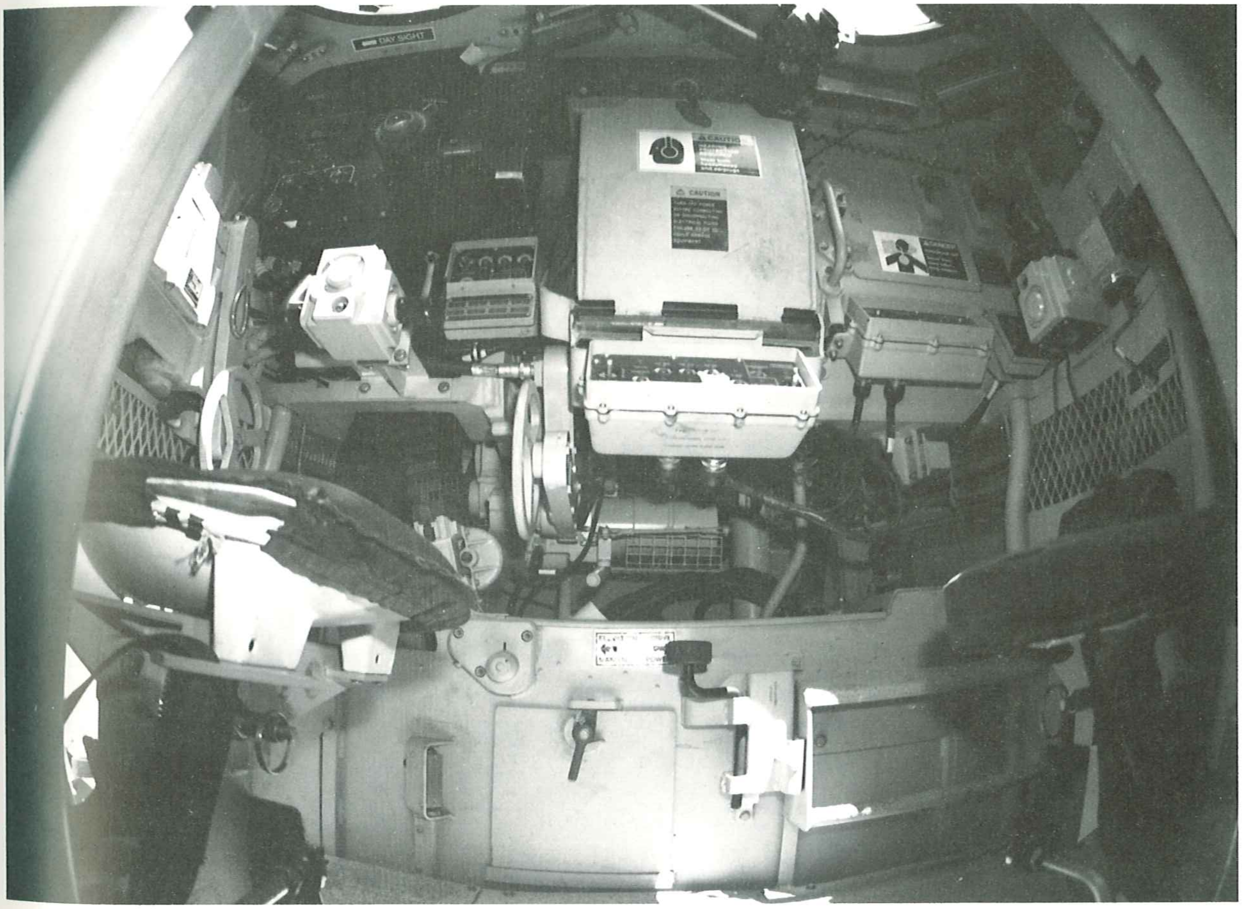


million, compared to $0.18 million for an M113A2 (six times the cost). This same cost problem has faced all armies attempting to acquire the new generation of infantry vehicles. The crux of the matter is whether the added capabilities justify the higher price tag. The Soviet, German and British Armies have felt that it does, and so does the US Army. (A fuller discussion of the relative merits of the Bradley vs. other infantry vehicles appears below.) Some of the critics argued that in lieu of the M2, an up-gunned M113 should have been purchased. This of course ignored the fact that over 60 per cent of the cost of an infantry fighting vehicle like the M2 is contained in the turret alone. Any armoured vehicle with a sophisticated, turreted weapon is going to be expensive, no matter how inexpensive the hull.

The Aluminium Controversy (yet again . . .)

Further fuel was thrown on the Bradley controversy in 1984 as a result of tests conducted by the Ballistics Research Laboratory at Aberdeen Proving Ground to test for aluminium armour 'vaporifics'. It had been alleged for many years that the effects of a shaped-charge impact were greatly amplified by the use of aluminium armour. No highly controlled vaporifics tests had ever before been conducted on aluminium armoured vehicles, owing to the cost of such tests, as well as to the absence of verifiable instances of this phenomenon occurring in combat. A number of countries have used aluminium-armoured vehicles in combat, notably the US with its M113s in Vietnam; but there were no reliable reports of amplified damage due to the use of aluminium armour. Nevertheless, the Army decided to conduct such tests even though it had already completed all the legally mandated tests-to-destruction of Bradleys. On the completion of the tests, an Air Force officer in the Department of

A view looking up from the rear squad compartment into the Bradley turret. This does not have the typical 'feel' of most armoured vehicles, since the turret is free of a protruding gun breech. The gun is completely enclosed to prevent fumes from leaking into the vehicle. (Author)



A platoon of M2 IFV Bradleys of the 41st Infantry, 2nd Armored Division at Ft Hood, Texas. This was the first division fully reorganised under the 'Div 86' plan with M1 tanks and M2/M3 Bradleys. (Author)

Defense charged that the tests were insufficiently realistic and had been 'rigged'. These charges were eventually leaked to the Press, and set off considerable further criticisms of the programme.

The tests had aimed at determining whether the selection of aluminium rather than steel armour does increase the lethality of hostile shaped-charge warheads. Aluminium had been chosen for the Bradley due to its relative strengths compared to steel. A plate of aluminium armour, equal in protection to a plate of steel armour, is slightly lighter but much thicker. Because it is thicker it has greater structural rigidity, and so obviates the need for certain internal bracing needed with steel. An IFV using aluminium armour weighs about one ton less than an identical vehicle protected to a comparable level with steel. A number of other armies have also chosen aluminium for their light armoured vehicles. (Actually, the Bradley is not protected by homogenous aluminium armour, contrary to the widespread view. The mantlet is steel armour, and the hull and turret sides are protected by a special laminate of spaced aluminium and alternating steel plates.)

The tests were conducted against vehicles worn out in previous tests. They were instrumented, and loaded with dummies to simulate the crew. The instrumentation aimed at discovering whether a shaped-charge hit caused lethal gases, blinding flash, enhanced spalling, or overpressure (concussion) when compared to the use of such a shaped charge against comparable steel armour. A variety of weapons was used, from RPG-7 equivalents all the way up to anti-tank missiles (which have a shaped-charge warhead larger than any current Soviet anti-armour weapon). The test results showed that there was no significant increase in lethality due to the use of aluminium. There was enhanced overpressure and flash compared to steel armour, but not enough to increase the lethality of the warhead. The tests demonstrated what had already been suspected from past combat experience with aluminium-armoured vehicles: crew in the path of the spall cone would be fatally wounded, whereas crew outside the spall cone would suffer from some overpressure effect, largely dependent on the size of the warhead. The tests also suggested that steel armour may actually have slight lethality enhancement effects compared to aluminium, since the steel spall tends to transmit the kinetic energy of the warhead hit more effectively than the less dense aluminium.

The conduct of the test was distorted by critics of the programme. The Air Force officer's report complained that the vehicle was not fully combat loaded with fuel and ammunition. He contended that this was done to avoid the dramatic internal fires that would have resulted had the vehicles been so loaded. However, it is not clear why the vehicle should have been so loaded since the aim of the tests was to examine the vaporifics issue, not the vulnerability of the Bradley to specific weapons which had already been tested. The report also complained that the test had been 'rigged' when the dummies inside had been wet down at one point to prevent their uniforms from burning. The suggestion was that this was done to hide the burn injuries that would be suffered. This charge ignored long-proven evidence regarding the lethal mechanisms of shaped-charge warheads, namely the concussion and lethal cone of hot gas and metallic spall thrown into the crew compartment by the warhead. Minor clothing burns are irrelevant to the lethal effects of the warhead, and smouldering clothing contaminates tests aimed at measuring lethal gases resulting from the blast itself.

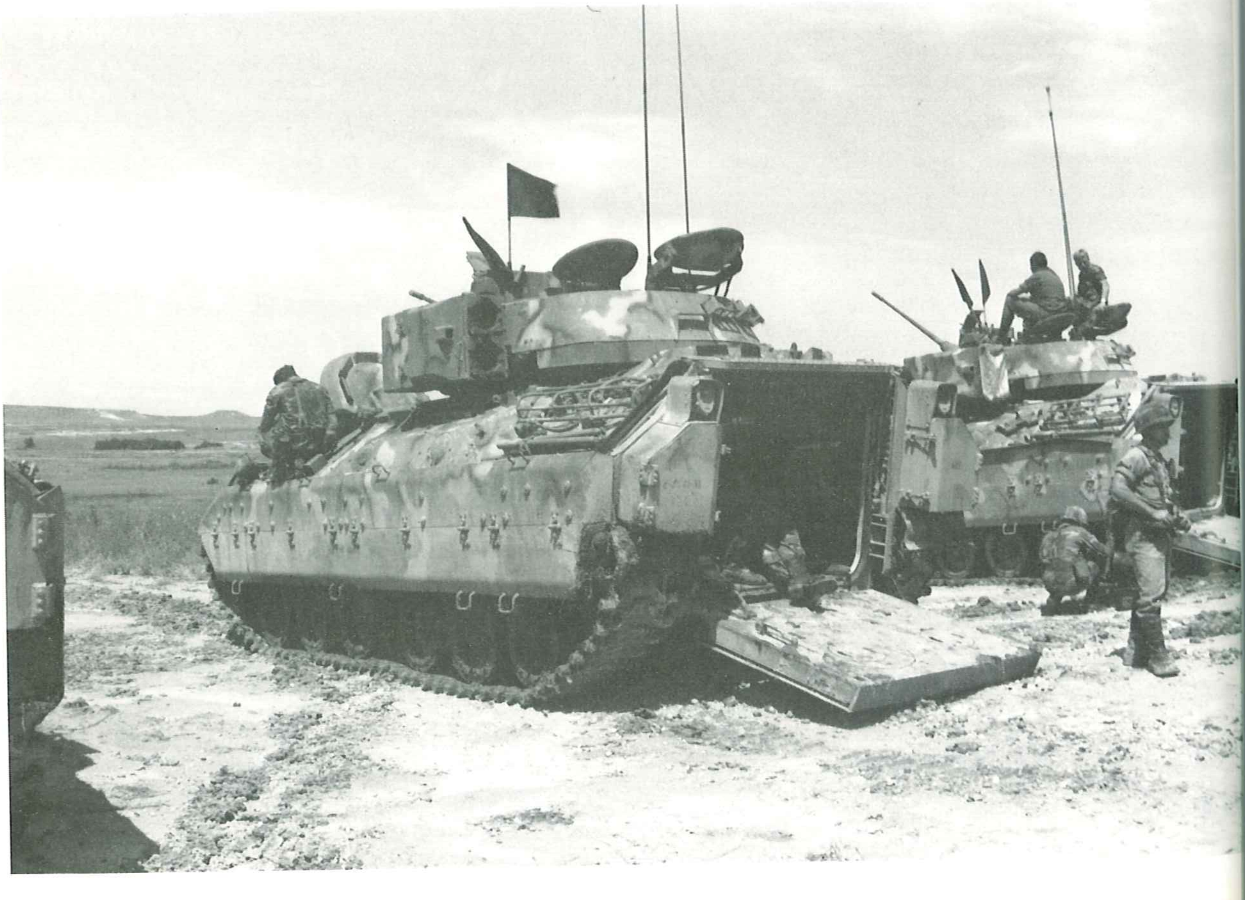
Although the complaints about the test were largely refuted, the report resurrected the issue of the inadequacy of light armoured vehicles when subjected to weapons designed to cripple much more heavily armoured tanks. As examined earlier, the decision to limit armour on infantry fighting vehicles has been due to both cost and tactical features. Like much of the criticism in the US Press,

On a baking hot day on the Texas prairie, a Bradley crewman prepares an ammunition load for a live firing exercise. The 25 mm ammunition is stowed in the black plastic boxes seen in the foreground. (Author)

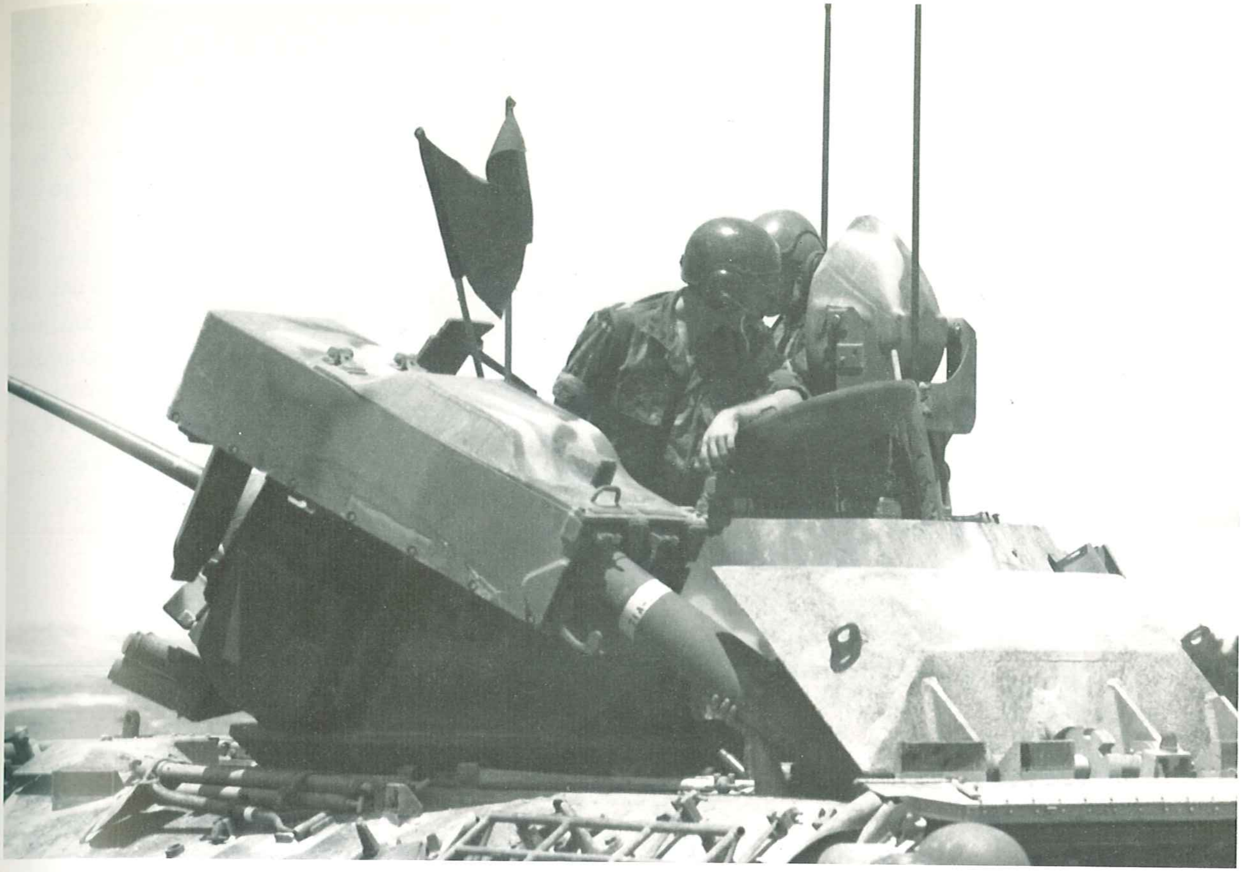
the underlying issues of this complicated question were completely ignored in favour of the more sensational aspects of the charges. The M2 Bradley was labelled a 'death trap' and a 'crematorium' in the newspapers and weekly magazines, and the Army brass was castigated for its 'callous disregard' for the safety of its troops. The fact that the Bradley is more heavily armoured than any other armoured infantry vehicle in production was ignored. Nor did any of its Press critics suggest they would support a programme for a heavy infantry vehicle with all its attendant higher costs. What is especially disturbing about such Press excesses is that, in a vote-sensitive democracy, they can detrimentally alter weapons programmes, in spite of their lack of substance. Since most of the Press is woefully ill-educated on defence matters, it plays little constructive rôle in shaping weapons policy. The Press made no attempt to shape the configuration of the Bradley in the late 1960s and 1970s when the design was still in progress. But once millions of dollars have been spent designing and building such equipment, the Press feels no compunction in criticising the results and calling for the termination of the programme.

The Bradley Described

The M2 IFV and M3 CFV are almost identical externally; they differ mainly internally. The main external differences are the absence of firing port periscopes on the right side and the plating-over of firing ports on the M3. Internally, the main differences are in the rear troop compartment. The M2, being a squad carrier, has seating for six to seven men (in addition to the driver, gunner and squad/vehicle leader in the turret). In contrast, the M3 CFV carries only two men in the rear. Some thought was given to using the additional space in the M3 to carry a scout motorcycle. This idea was



Squad exit from the Bradley is through the power-assisted rear ramp. The two bins on either side of the ramp contain stowage, ammunition and MREs (Meals-Ready-to-Eat). (Author)



The TOW missile launcher can be reloaded from under the protective cover of the rear cargo hatch, as seen in this view. (Author)

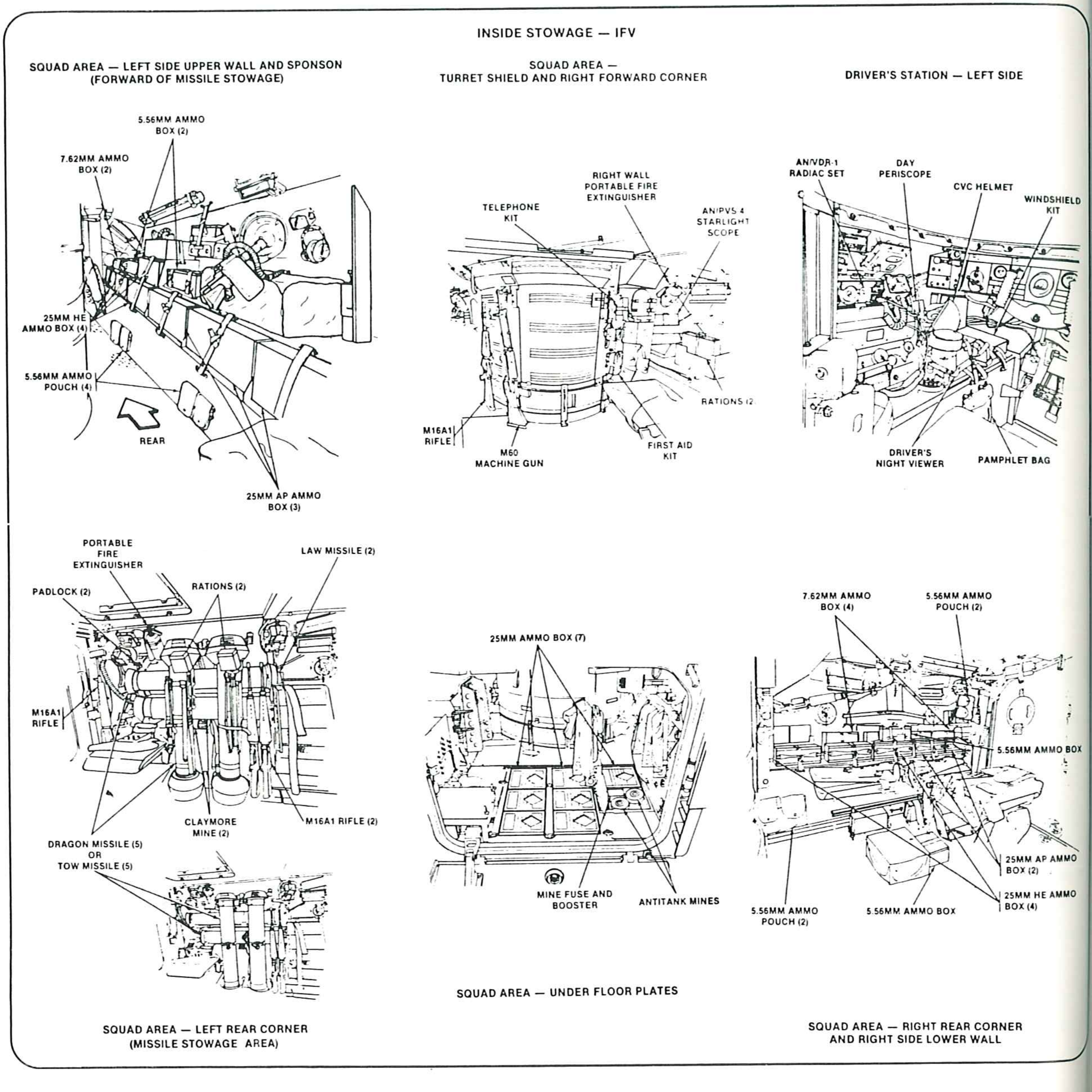
eventually dropped due to the hazard presented by the motorcycle's unprotected gasoline tank in such a confined space. Instead, the M3 is configured to carry additional rounds of TOW anti-tank missiles and other munitions.

The M2 IFV is configured differently from either the German Marder or the Soviet BMP. Like both these earlier vehicles, it has its engine up front, with the driver to the left. The placement of the engine and transmission provide a certain measure of additional protection to the turret and rear crew positions in the event of a hit on the hull front. The driver is provided with a hydrostatic steering system which is quite simple to operate, using a 'butterfly' steering yoke. Behind the driver and engine are the turret and squad positions. Since the turret is offset to the right, there is a tunnel between the driver's station and the rear crew compartment. Two of the squad sit in the tunnel, and operate the two left side M231 Firing Port Weapons (FPW). (The FPW is a sub-machine gun version of the M16A1 assault rifle, configured to fire only on automatic. It is provided with special ammunition with tracer to assist in aiming.)

The decision to adopt a firing port weapon in lieu of using an unmodified M16A1 was due to the length of the M16A1 and the difficulty of designing a firing port sufficiently secure to permit the use of a CBR (Chemical/Biological/Radiation) system. This has meant that each squad member has both a FPW while on board the IFV, and his regular weapons—either an unmodified M16, or another squad weapon such as the M249 SAW (Squad Automatic Weapon)—when dismounted. (It is the author's opinion that the US Army should have taken this opportunity to design a bullpup derivative of the M16 for use both as an FPW and as the normal weapon for the squad when dismounted.)

There has been some question as to the effectiveness of the firing port weapon concept, not only on the Bradley but on the Marder and BMP as well. The weapon is aimed using a periscope mounted above the ball-joint firing port. The weapon can only be aimed by adjusting fire after observing the fall of the tracer, since the normal sight cannot be used. This hardly results in sharpshooting. For this reason, FPW fire is usually referred to as 'suppressive': i.e., it is not accurate enough for precision, but may intimidate the enemy and force him to keep his head down. Nevertheless, such a weapon can pay important dividends in terms of crew morale. The squad is no longer a passive and vulnerable passenger in the infantry vehicle, but is expected to observe the terrain for enemy positions threatening the vehicle. Availability of a weapon to respond to enemy fire can help relieve the anxieties of the squad members, and focus their attention on the lay of the battlefield before they disembark for dismounted action. While such a configuration is not going to win any marksmanship prizes for Bradley squads, it is a considerably more effective configuration than the old 'battlefield taxi' layout.

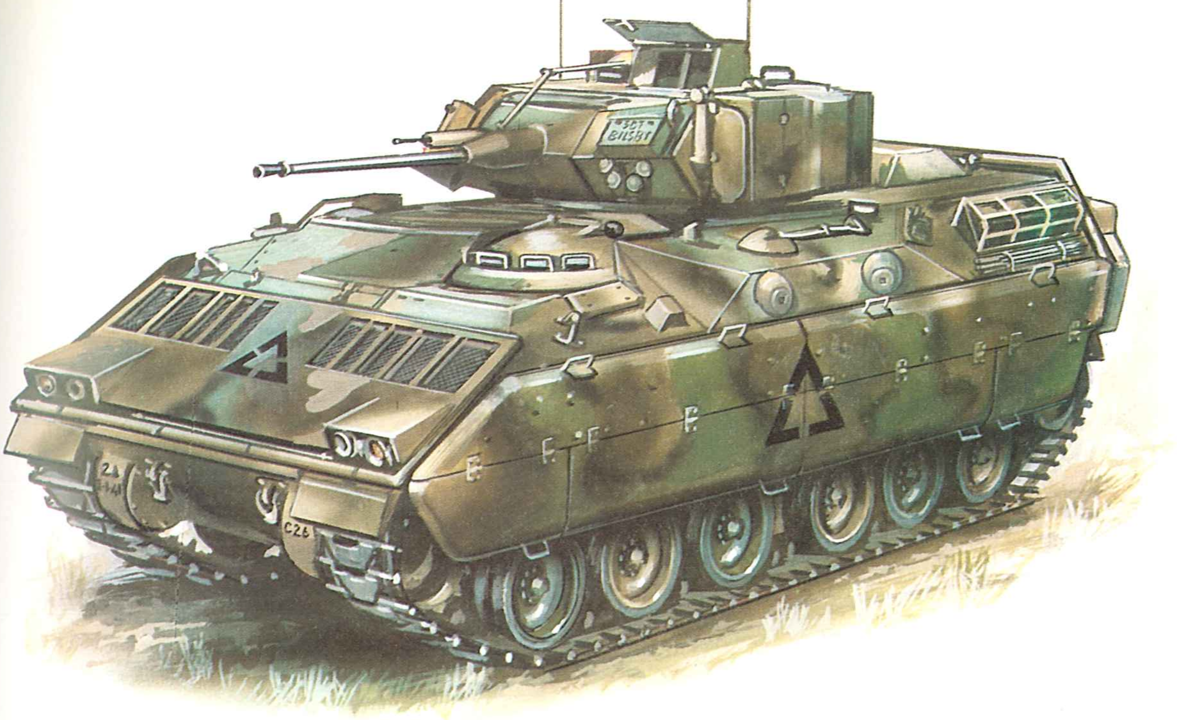
The rear squad compartment contains the remaining four members of the squad. Two are seated to use the two right side firing ports, and two by the rear firing ports. The rear area also contains additional 25 mm main gun ammunition stowage and additional TOW missile rounds. The TOW

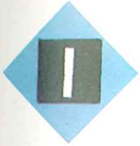


INSIDE STOWAGE — IFV

SQUAD AREA — LEFT SIDE UPPER WALL AND SPONSON (FORWARD OF MISSILE STOWAGE)
5.56MM AMMO BOX (2)
7.62MM AMMO BOX (2)
25MM HE AMMO BOX (4)
5.56MM AMMO POUCH (4)
REAR
25MM AP AMMO BOX (3)
SQUAD AREA — TURRET SHIELD AND RIGHT FORWARD CORNER
TELEPHONE KIT
RIGHT WALL PORTABLE FIRE EXTINGUISHER
AN/PVS 4 STARLIGHT SCOPE
RATIONS (2)
M16A1 RIFLE
M60 MACHINE GUN
FIRST AID KIT
DRIVER'S STATION — LEFT SIDE
AN/VDR-1 RADIAC SET
DAY PERISCOPE
CVC HELMET
WINDSHIELD KIT
DRIVER'S NIGHT VIEWER
PAMPHLET BAG
PORTABLE FIRE EXTINGUISHER
LAW MISSILE (2)
PADLOCK (2)
RATIONS (2)
M16A1 RIFLE
CLAYMORE MINE (2)
M16A1 RIFLE (2)
DRAGON MISSILE (5) OR TOW MISSILE (5)
SQUAD AREA — LEFT REAR CORNER (MISSILE STOWAGE AREA)
25MM AMMO BOX (7)
MINE FUSE AND BOOSTER
ANTITANK MINES
SQUAD AREA — UNDER FLOOR PLATES
7.62MM AMMO BOX (4)
5.56MM AMMO POUCH (2)
5.56MM AMMO BOX
25MM AP AMMO BOX (2)
25MM HE AMMO BOX (4)
5.56MM AMMO POUCH (2)
5.56MM AMMO BOX
SQUAD AREA — RIGHT REAR CORNER AND RIGHT SIDE LOWER WALL

1: M2 IFV, 1st Bn., 41st Inf., 2nd Armd. Div.; Ft. Hood, Tx., 1984





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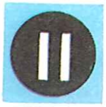

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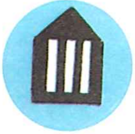

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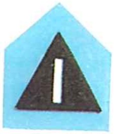

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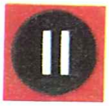

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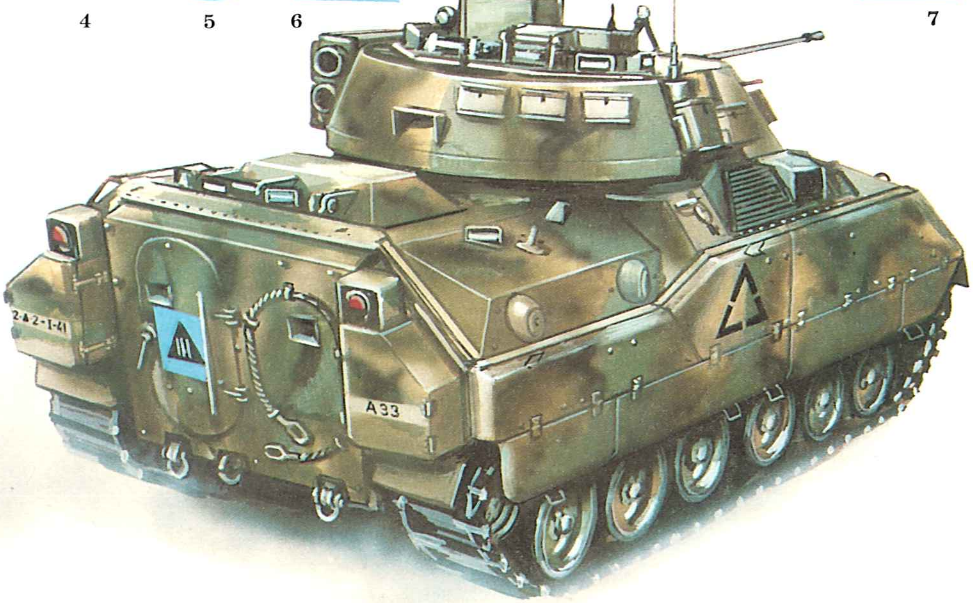
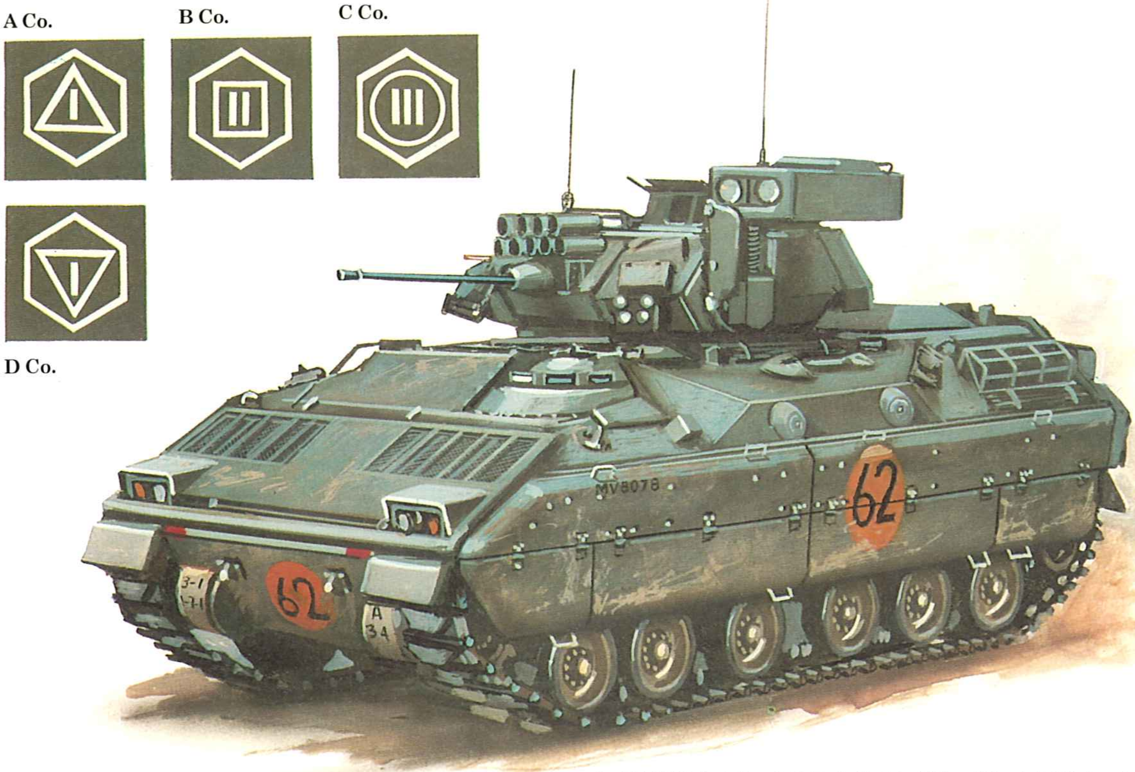
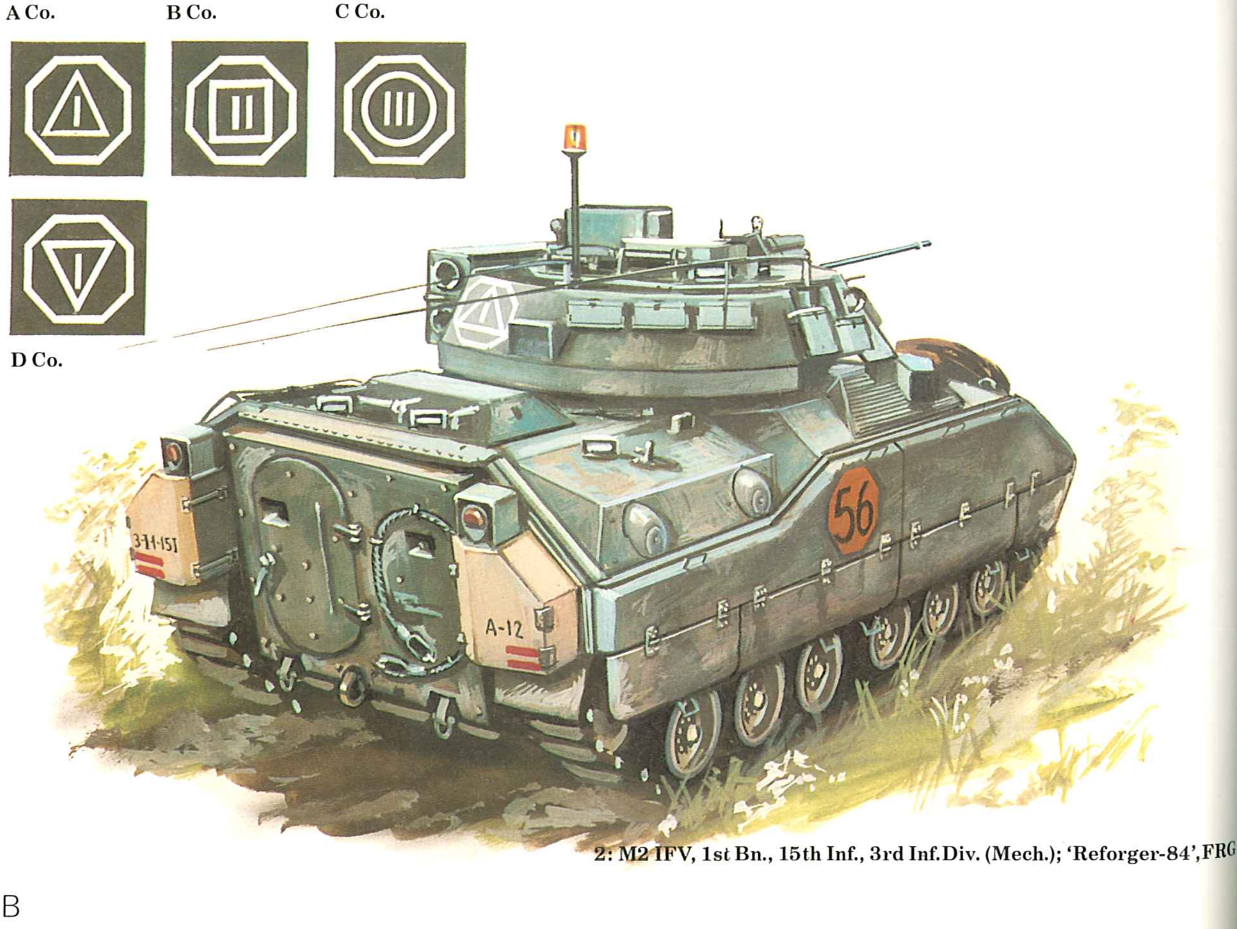


2: M2 IFV, 2nd Bn., 41st Inf., 2nd Armd. Div.; Ft. Hood, Tx., 1985

A

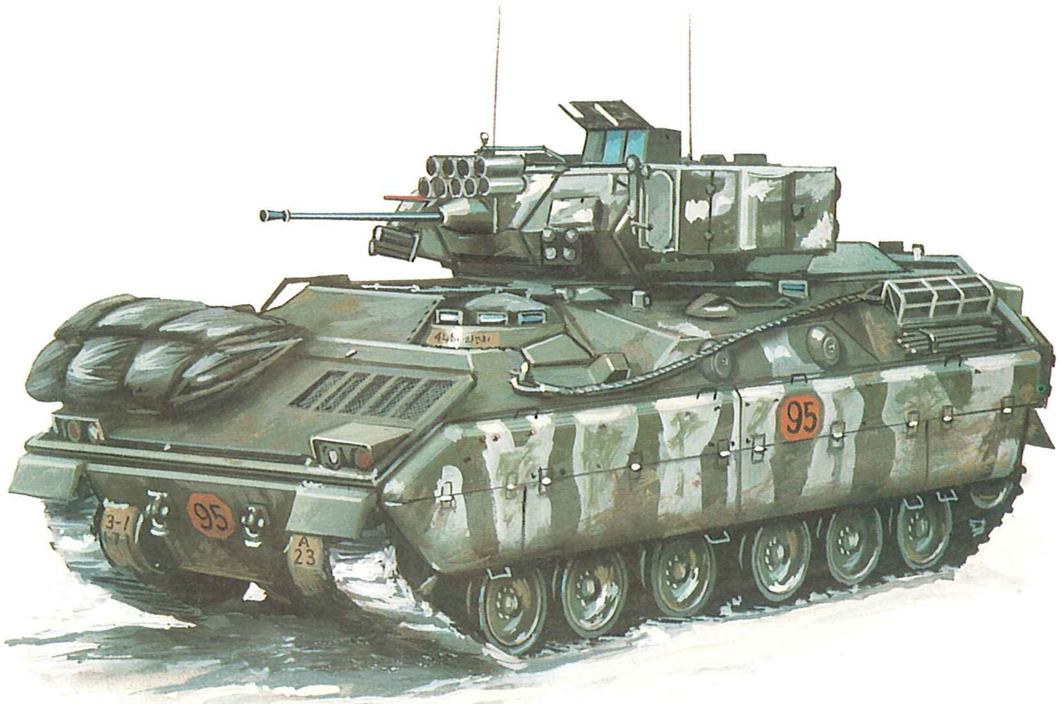

A Co.
B Co.
C Co.
D Co.
MV6078
62
3-1
1-1
62
A
34

1: M2 IFV, 1st Bn., 7th Inf., 3rd Inf.Div. (Mech.); 'Reforger-84', FRG

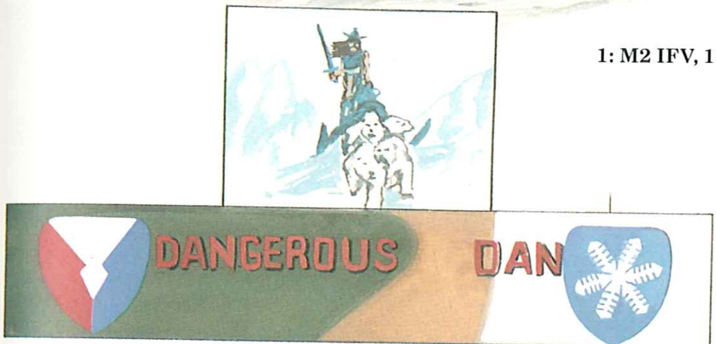

A Co.
B Co.
C Co.
D Co.
56
3-1-15I
A-12

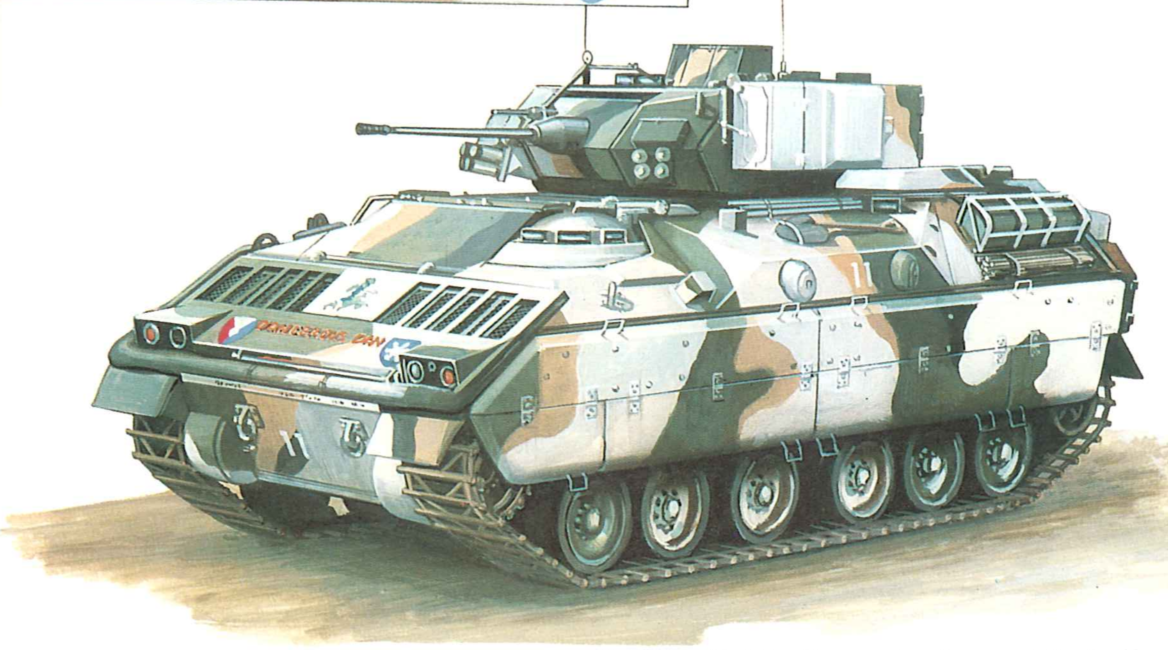
2: M2 IFV, 1st Bn., 15th Inf., 3rd Inf.Div. (Mech.); 'Reforger-84', FRG

B



1: M2 IFV, 1st Bn., 7th Inf., 3rd Inf. Div. (Mech.); 'Reforger-85', FRG

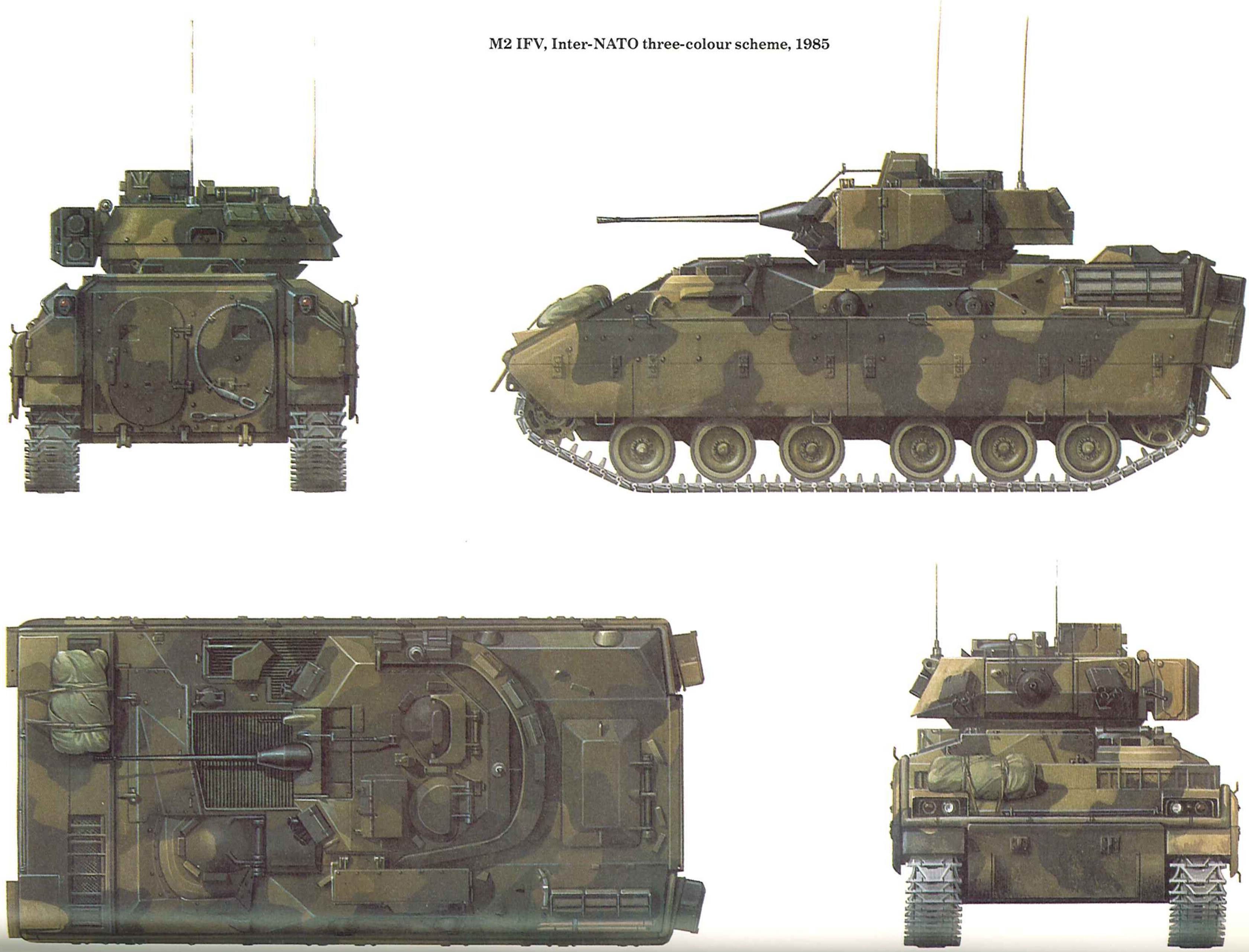

DANGEROUS DAN


DANGEROUS DAN
11

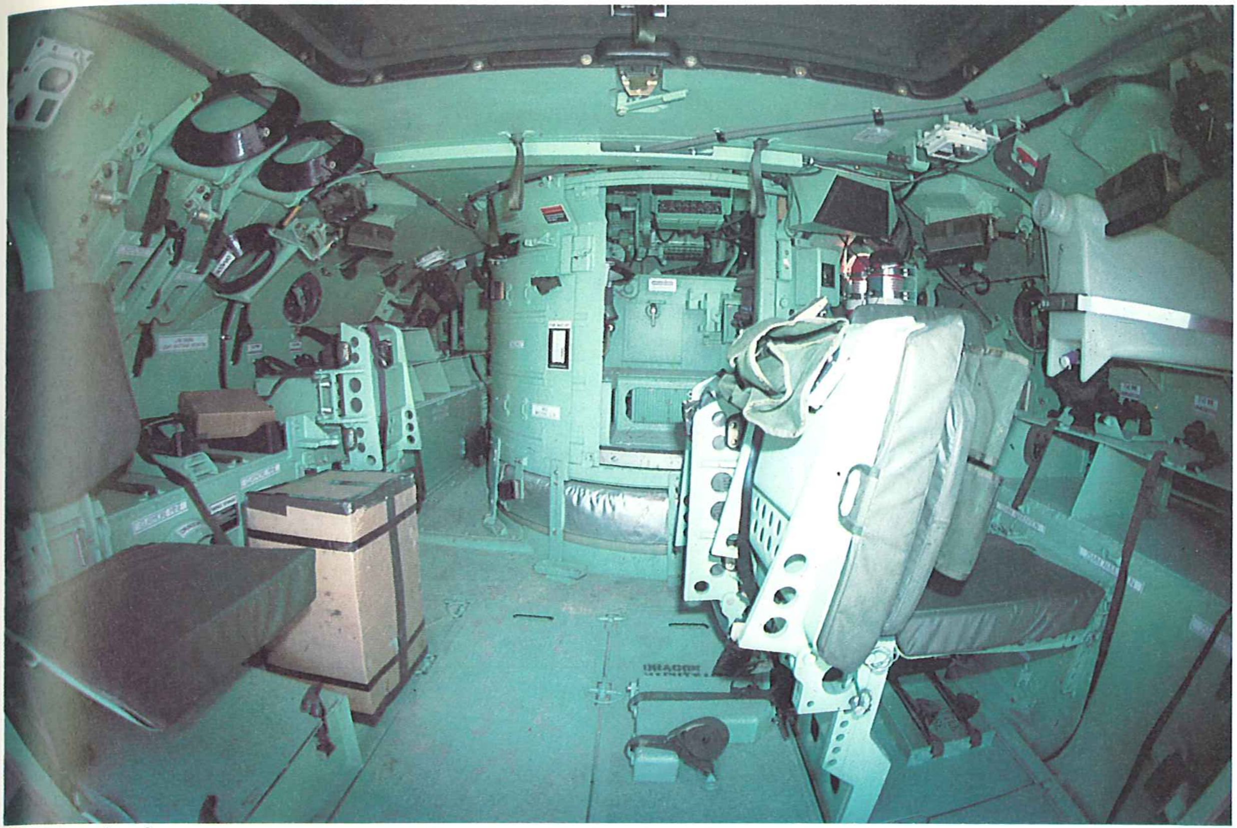
2: M2 IFV, USA Cold Regions Test Center; Ft. Greely, Alas., 1984

C

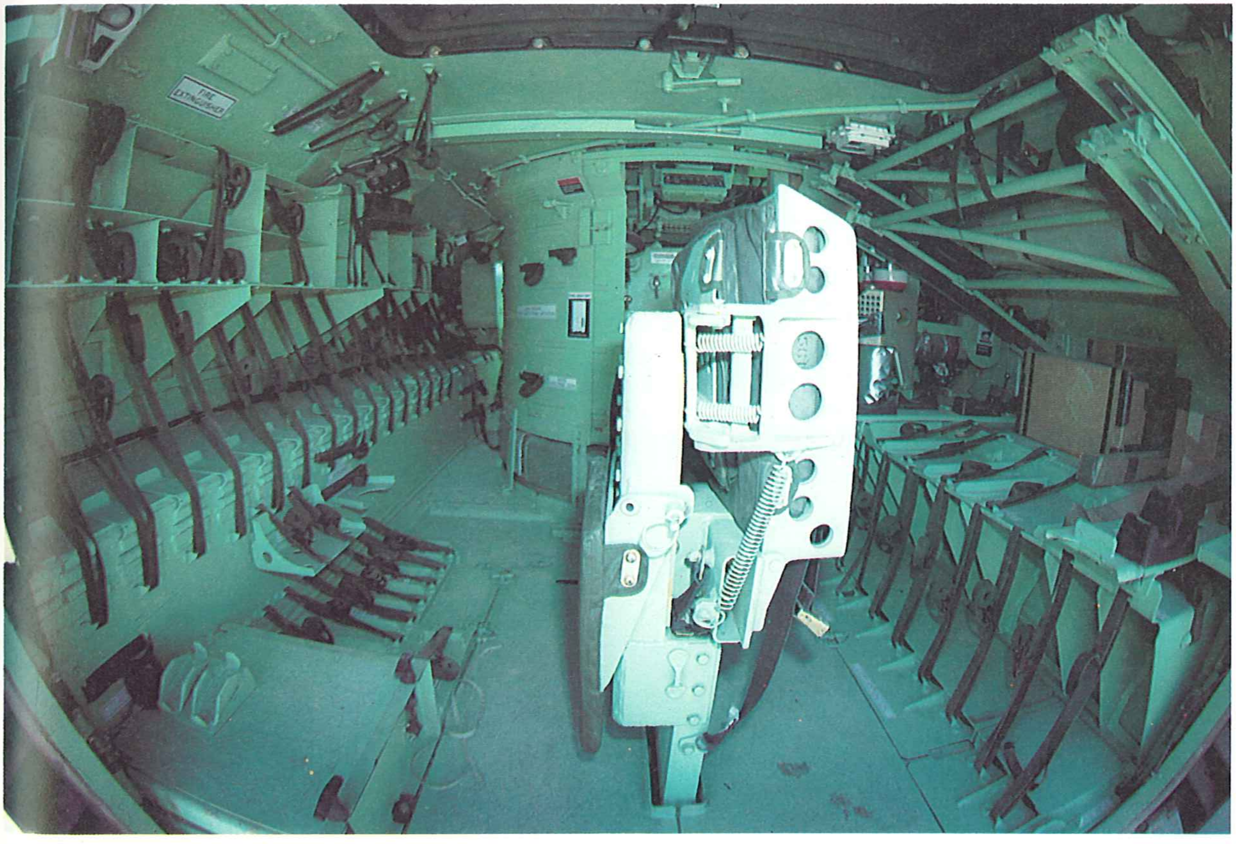
D



M2 IFV, Inter-NATO three-colour scheme, 1985

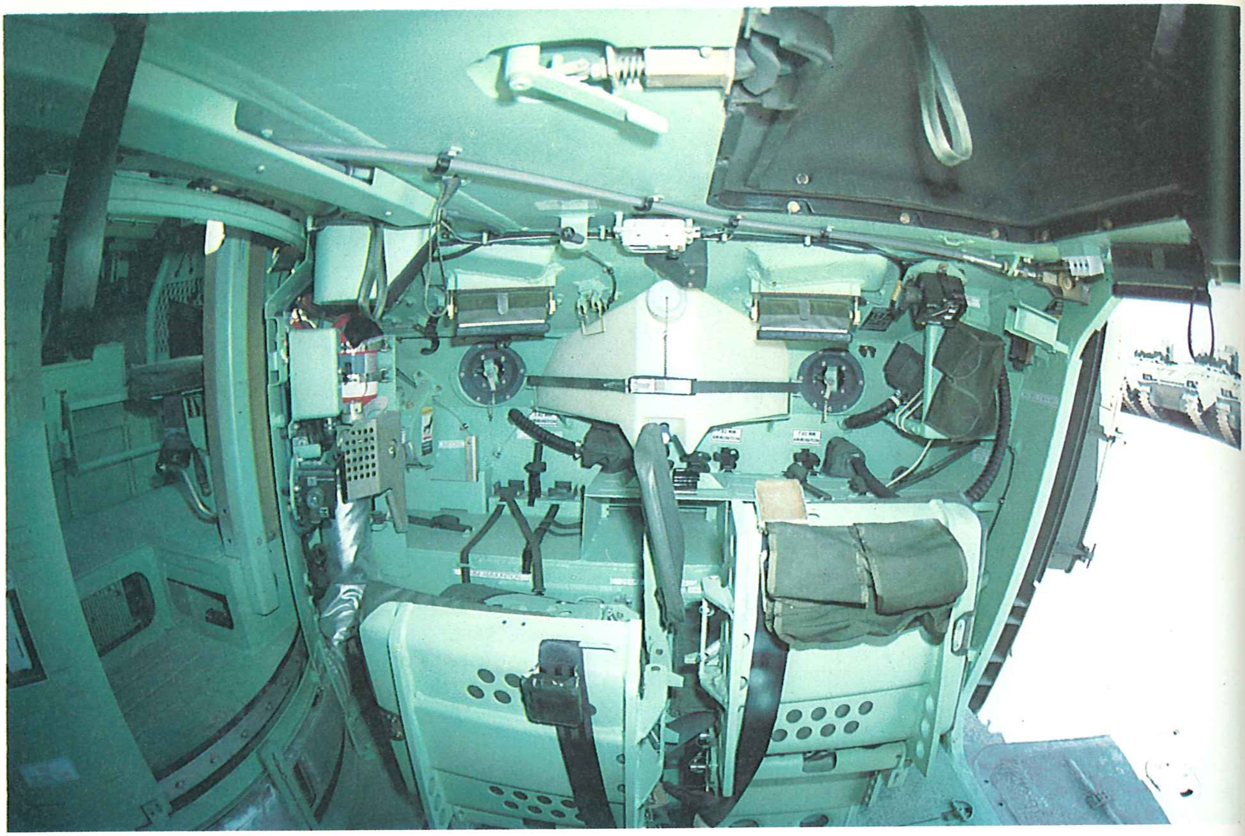


1: M2 interior, from rear

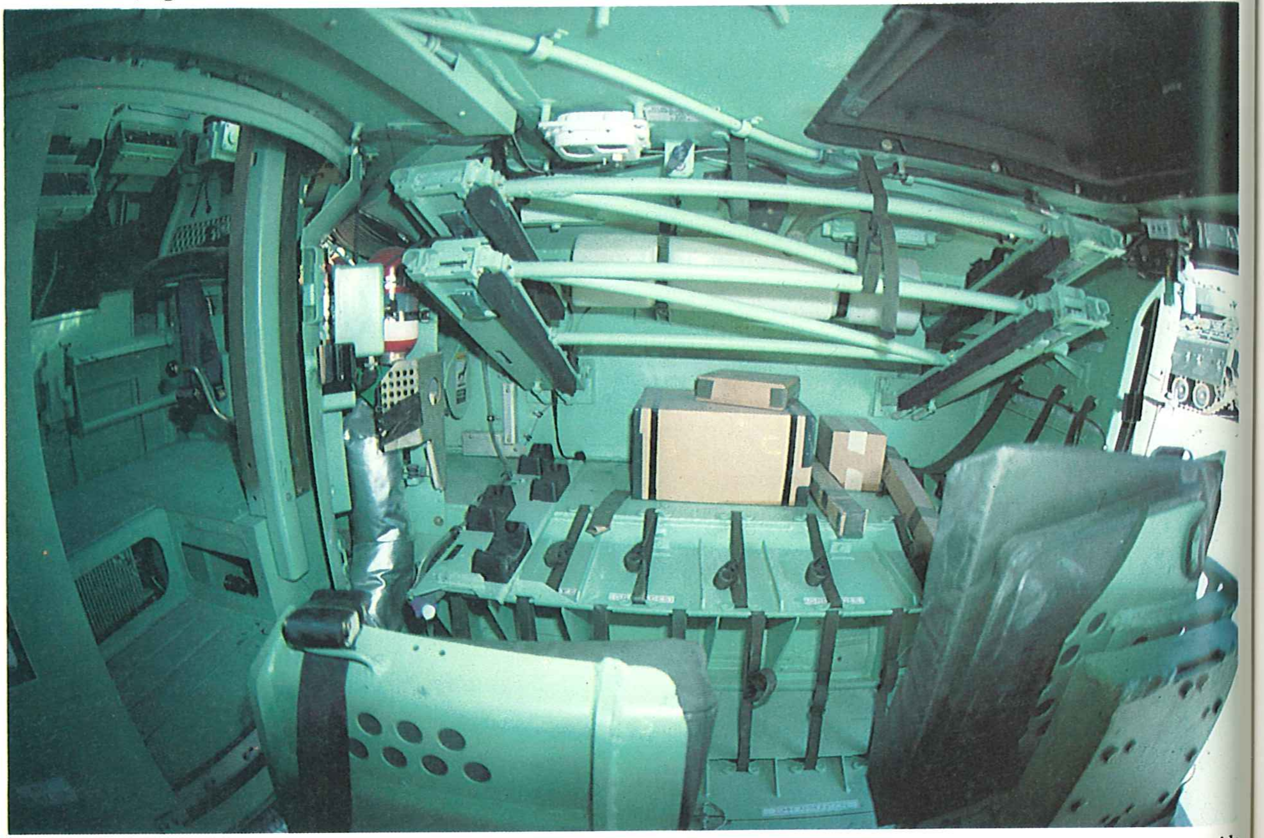


2: M3 interior, from rear

E

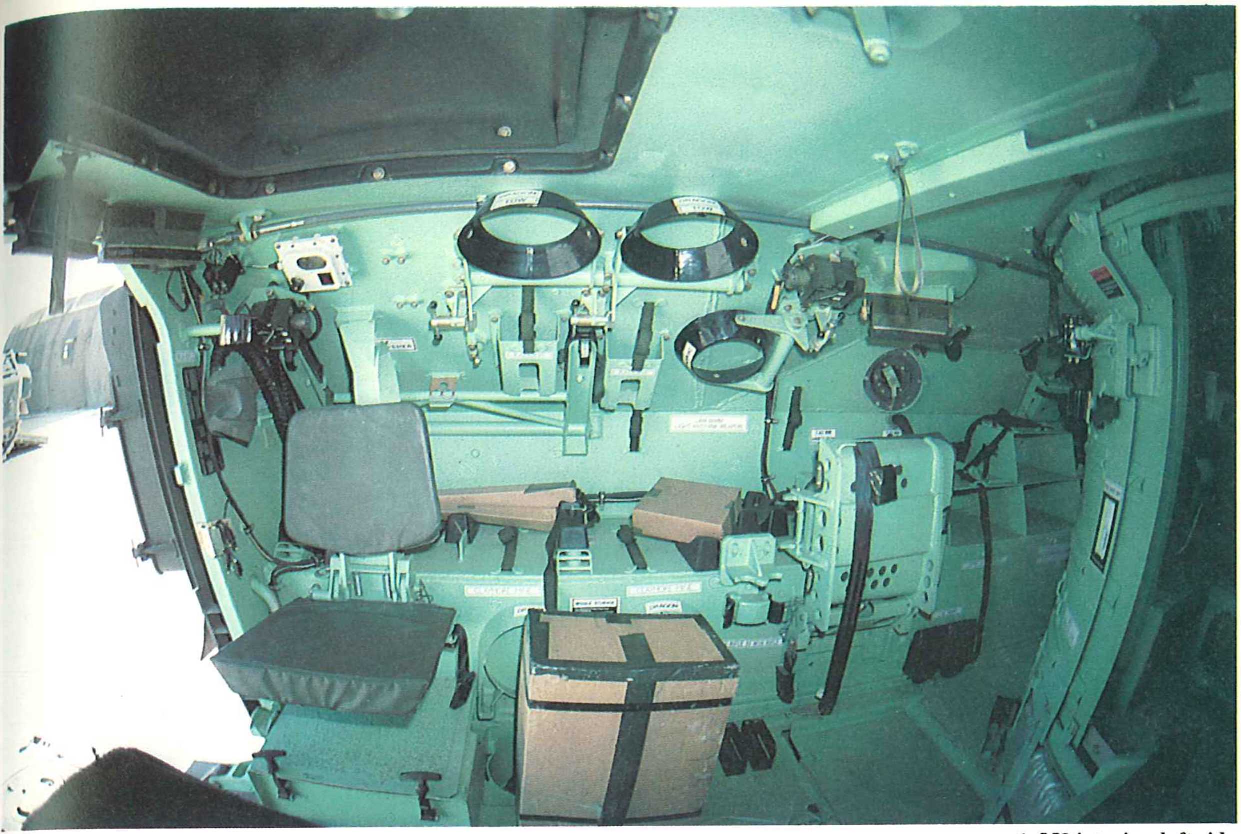


1: M2 interior, right side

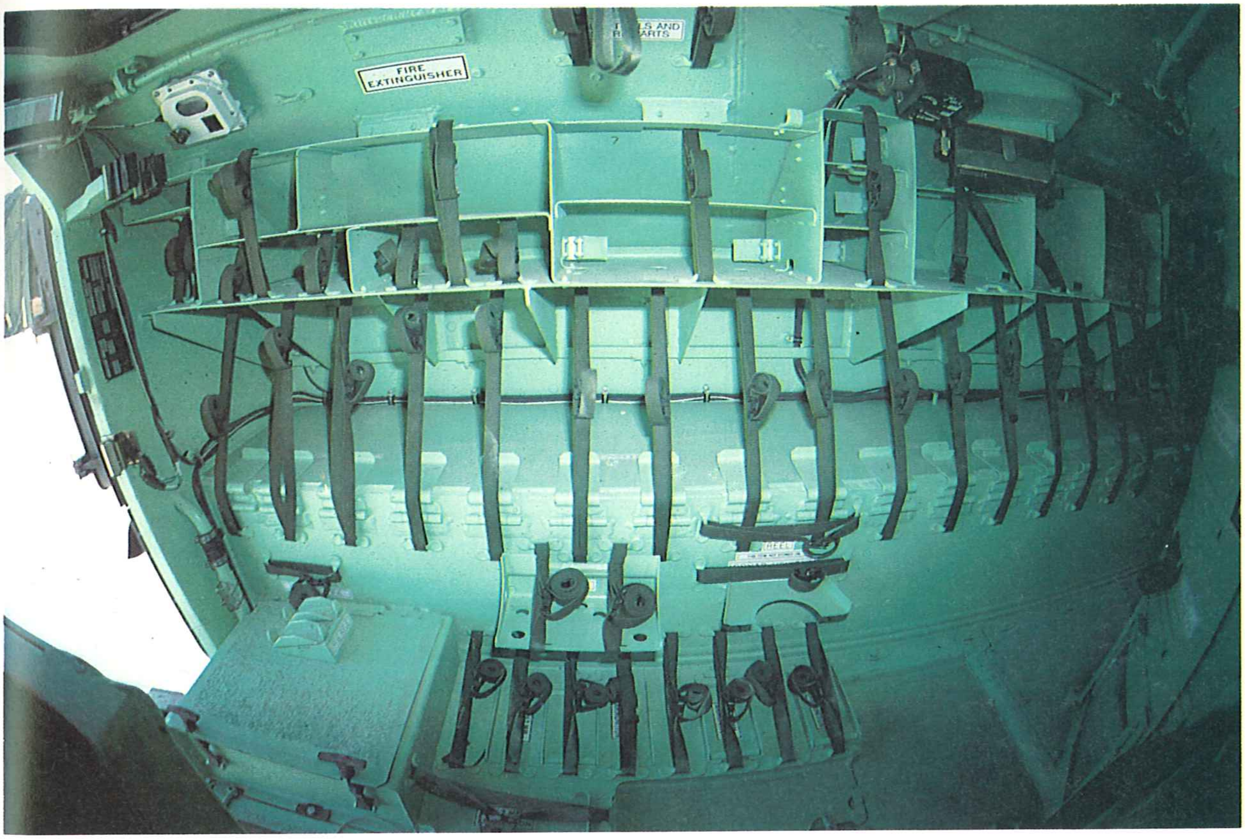


2: M3 interior, right side

F

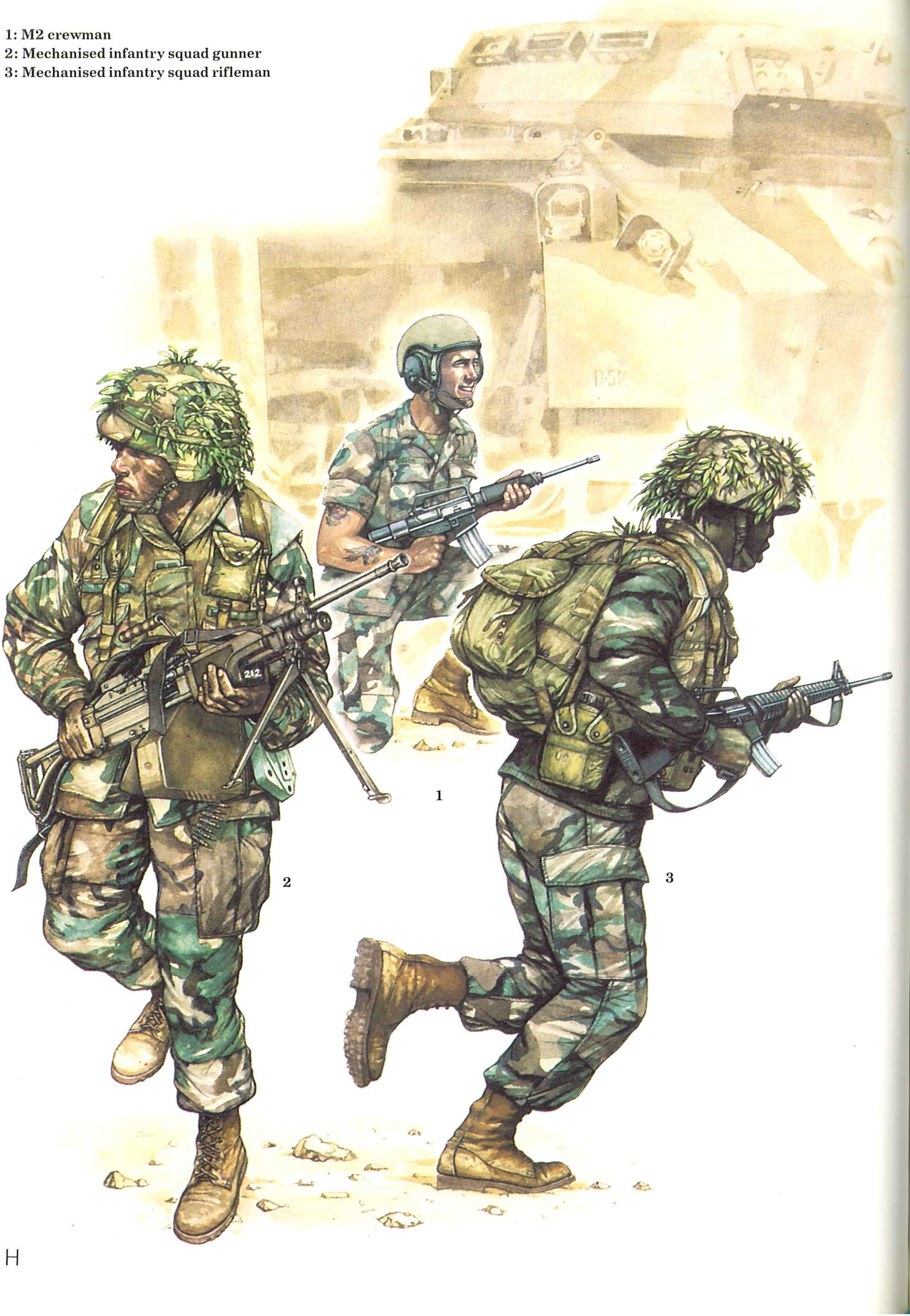


1: M2 interior, left side


FIRE EXTINGUISHER

2: M3 interior, left side

1: M2 crewman
2: Mechanised infantry squad gunner
3: Mechanised infantry squad rifleman

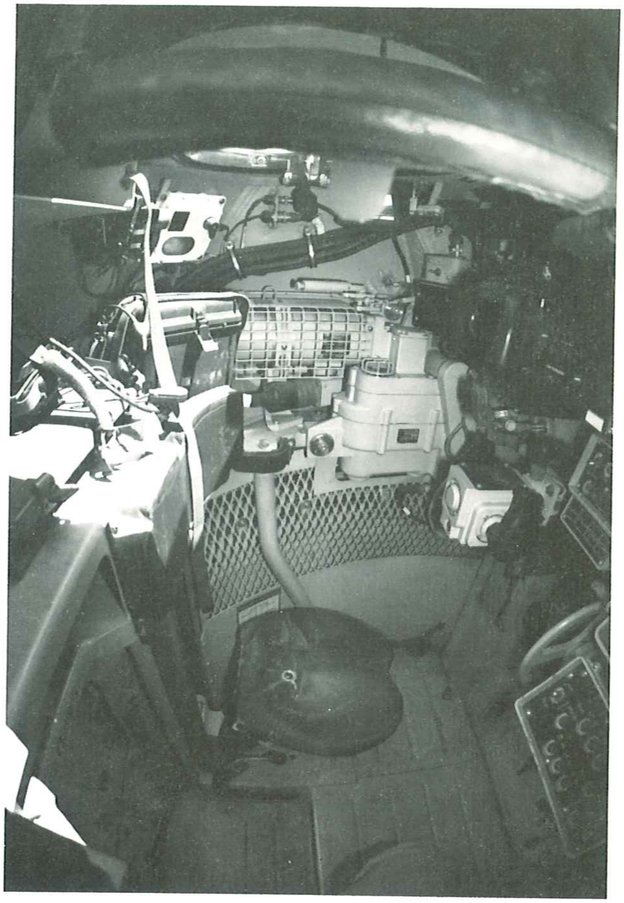


H

launcher on the turret carries two rounds. Once these are expended, the launcher can be reloaded by one of the squad members in the rear compartment using the rear roof hatch. The hatch is designed to be partly opened, giving the TOW loader total overhead protection during the loading process, and minimally exposing him to hostile fire. Access to the troop compartment is through the large rear drop ramp, or through the door located in the ramp. The upper hull hatch is not intended for access or egress.

The turret is longitudinally in the centre of the Bradley, offset to the right side. It is armed with an M242 25 mm Bushmaster externally-powered 'Chain Gun', a co-axial M240 machine gun, smoke dischargers, and an elevatable twin TOW launcher. The turret is occupied by the squad/vehicle leader on the right and the gunner on the left. The squad leader is provided with all-around vision periscopes. In addition, he is provided with a special hatch that can be locked above his head, permitting him to look outside the vehicle without using the periscopes, while at the same time offering total overhead armour coverage from shell bursts. The controls for the vehicle's weapons are duplicated at both the commander's and gunner's stations, to allow either crewman to operate and fire all the vehicle's weapons. Due to this feature, either member of the turret crew can disembark with the remainder of the squad to bolster their numbers if need be. The main advantage of this configuration over that of the BMP-1 or Marder is that it provides the squad leader with a good view all around the battlefield. Furthermore, he is not as isolated from his squad as is the case in the BMP or Marder.

The weapons are aimed using an Integrated Sight Unit (ISU), which incorporates both a daylight sight system and a thermal imaging night system. The thermal imaging night system can also be used during the day to view through clouds of dust, smoke or haze. This can have a tactical advantage, since a Bradley can screen itself with smoke while still able to target enemy vehicles beyond the smoke cloud. This advantage comes at a price: the ISU represents about a tenth of the total vehicle cost. The M242 Bushmaster cannon is fully stabilised, permitting the vehicle to fire on the move. Either a high or low rate of fire can be selected, the high rate of fire having a maximum of 200 rounds per minute. Normally, the gun is fired in bursts of four to six rounds, since a greater number can lead to greater round dispersion at long ranges. The usual mix of ammunition in the ready magazine is 75 rounds of armour-piercing and 225 rounds of high explosive. A further 600 rounds is stowed in the vehicle. The penetration performance of the current AP ammunition is classified; but from examination of range targets it is quite evident that it will easily slice through the armour of any Soviet armoured infantry vehicle or other light AFV. New ammunition being developed for the 25 mm gun will extend this performance, and will probably enable the gun to penetrate the side armour of most main battle tanks. To deal with tanks, the Bradley has the twin TOW launcher. This is elevated for firing, and the missile controls are integrated into the ISU day/night sight to permit firing under nearly any conditions. The current M2 IFV can fire the TOW and I-TOW


Turret interior, left side, showing the gunner's station.

DRAGON TOW
DRAGON TOW

missiles, and there are plans to modify the vehicle to fire the improved TOW-2.

The M3 CFV is nearly identical to the M2, except for the rear compartment. The internal stowage on this version is different, accommodating more ammunition. The turret weapon system is identical in all respects.

The Bradley is amphibious after preparation. A flotation screen is contained along the hull sides, and is erected prior to entering the water. The Bradley is powered through the water using its tracks, and can be 'swum' across rivers and lakes without strong current or wave action. Constraints on its swimming are similar to those for most other amphibious armoured vehicles except for 'dedicated' amphibians like the LVT-7 amtracs.

Opposite, above
In contrast to the interior views of the M2 IFV shown in colour on Plates E, F and G, this photo shows the left hand side of the vehicle with the ammunition and TOW missiles stowed. (Author)

Opposite, below
Inside an M2 IFV, with the right hand side equipment fully stowed. The seats in the centre are folded up. (Author)

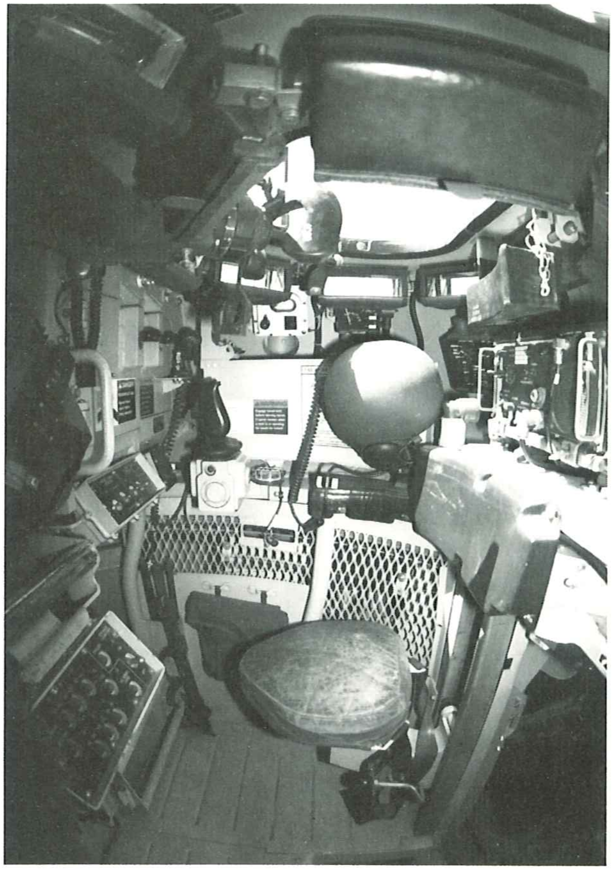
Mechanised Infantry Organisation and Tactics

The Bradley was developed concurrently with the US Army's new Division 86 organisation and doctrine. The new 'Div 86' heavy divisions will be equipped with the M1 tank and M2 IFV in lieu of the older M60A3 tank and M113 APC. The Div 86 follows the new H-series TOE (table of organisation and equipment) as compared to the J-series TOE used with M113 battalions. It is worth comparing the two mechanised infantry battalions, as they serve to place the capabilities of the Bradley in better focus.

Under the H-series TOE, a Bradley mechanised infantry battalion has four rifle companies, instead of the three companies in a J-series TOE for an M113 battalion. There are 13 Bradleys in each rifle company, organised into three platoons of four vehicles each and a company commander's vehicle. This gives the battalion a total of 54 M2 IFVs (counting the battalion commander's and the S3's vehicles). The other change from the M113 battalion has been the amalgamation of the combat support company into the headquarters company, and the creation of an anti-tank company using the battalion's 12 M901 ITV tank destroyers. The battalion support platoon has additional fuel- and ammunition-hauling capability, with more trucks and trailers. Other armour in the new battalion includes six M3 CFVs in the battalion headquarters company, as well as six M106 4.2 in. self-propelled mortars (based on the M113 chassis). These new weapons give the battalion considerably more firepower than previously. The J-series TOW M113 battalion has only 22 long-range anti-armour weapons consisting of TOW launchers and M901 ITV tank destroyers: in contrast, the new H-series TOE M2 battalion has 72. When the wealth of 25 mm guns are factored in, the new battalion has 132 long-range anti-armour weapons.

The firepower of each platoon is equally impressive, even though the Bradley squads are

Turret interior, right side, showing the squad leader's station. Also evident is the squad leader's CVC helmet, which he swaps for a normal infantry armoured helmet on leaving the vehicle. (Author)



smaller than the old M113 squad. In each platoon, three rifle squads are formed from the four Bradleys. Each Bradley retains a 'fighting vehicle team' consisting of the driver, gunner, and either the assistant squad leader or the squad leader. Each of the three squads consists of a squad leader (or assistant squad leader) armed with an M16A2, a machine gunner (M60 7.62 mm machine gun), an anti-armour specialist (Dragon anti-tank missile), two automatic riflemen (each with an M249 SAW), a grenadier (M16A2 with M203 40 mm grenade launcher) and a radio operator with a PRC-68 radio and M16A2. Normally, three M72A2 LAW anti-armour rockets are also carried by the squad. Currently, the platoon has no organic anti-aircraft weapon like the SA-7 which can be carried in the Soviet BMP. However, as in the Soviet case, anti-aircraft resources could be shared out below battalion level if and when required. In any event, the 25 mm gun on the M2 can be used against helicopters at need, having first-class long-range performance, a long-range sighting system, and excellent anti-armour lethality (when dealing with armoured helicopters like the Mi-24 Hind).

Under newer US doctrine, the platoons are being trained in a small number of well-executed drills aimed at providing different responses to various types of hostile actions. Company training stresses a variety of mounted and dismounted tactics depending on the circumstance. Dismounted tactics include exit from the Bradleys prior to reaching the objective, on top of the objective, or after having overrun the objective. Dismounted action is planned for occasions when the terrain is not suitable for mounted action, such as in forests, or due to heavy anti-armour fire; to clear an obstacle, to conduct a foot patrol, to conduct actions in an urban area, to clear out an objective, or to set up defensive positions.

Although the Bradley was designed to complement the M1 tank, there is a popular misconception that this means that M1s and M2s will fight alongside one another. Actually, M1 and M2 *units*

An M2 of the 3rd Infantry Division (Mechanized) during the 1984 'Reforger' exercises in Germany. This was the first unit equipped with the Bradley in Europe. (Pierre Touzin)

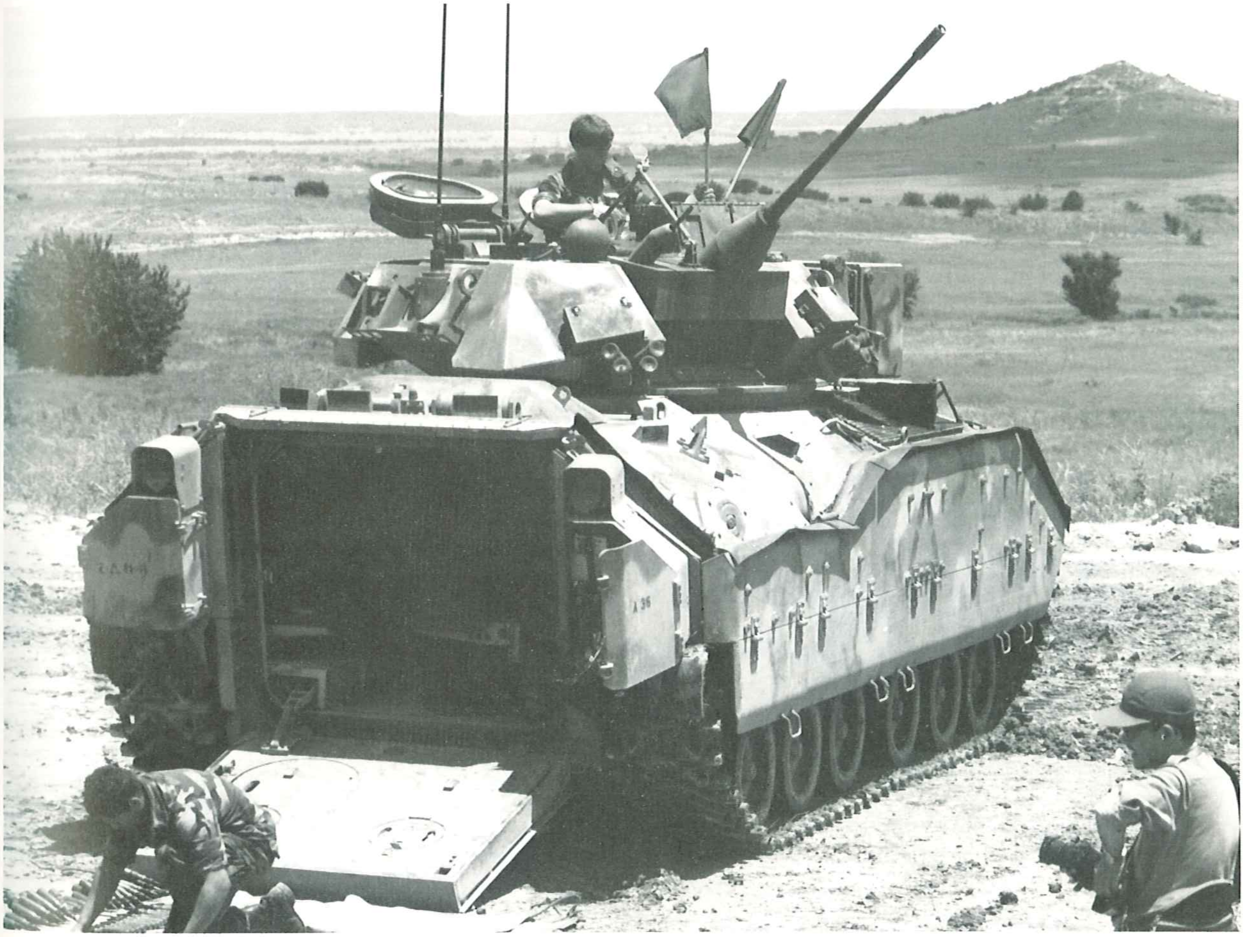
will fight alongside each other. Combined arms tactics involve the use of task forces which might include an M1 tank battalion and an M2 Bradley battalion. Smaller task forces could be formed using Abrams tank battalions and Bradley battalions should the circumstances warrant such actions. However, there have never been plans to actually mix the vehicles in a single unit. A typical operation would see the M1 unit in the vanguard, where the tank armour can better fend off anti-armour weapons. The Bradley unit behind can provide covering fire from its guns against anti-tank positions, and can also engage enemy armour with its TOW missiles. Should the anti-tank positions be too secure to be dealt with or bypassed by the tanks, the Bradley infantry squads can be brought forward for dismounted action to clear them. Such tactics aim to make maximum use of the capabilities of both vehicles, while minimising the risk of exposing the Bradley's more modest armour to the full weight of anti-armour weapons.

IFV vs. BMP

The M2 Bradley is more comparable to the newer Soviet BMP-2 than to the BMP-1. The BMP-2 is an evolutionary outgrowth of the BMP-1, which differs mainly in having a new, larger two-man turret with a 30 mm autocannon in lieu of the older 73 mm low-pressure gun. In this respect the Soviets have been paralleling US IFV development. Many details of the BMP-2 are not yet known, and certain aspects of the M2 Bradley remain classified. Nevertheless, a tentative comparison is possible.

In the area of firepower, the vehicles are fairly evenly matched. The 25 mm Bushmaster and Soviet 30 mm gun probably have similar performance in terms of range and penetration, as Soviet penetrator and propellant design would seem to be slightly behind US technology. Little is known of

An M2 of the 41st Infantry being prepared for an ARTEP exercise in summer 1983. The flags on the roof are used to signal the control tower on the status of the vehicle during training. (Author)



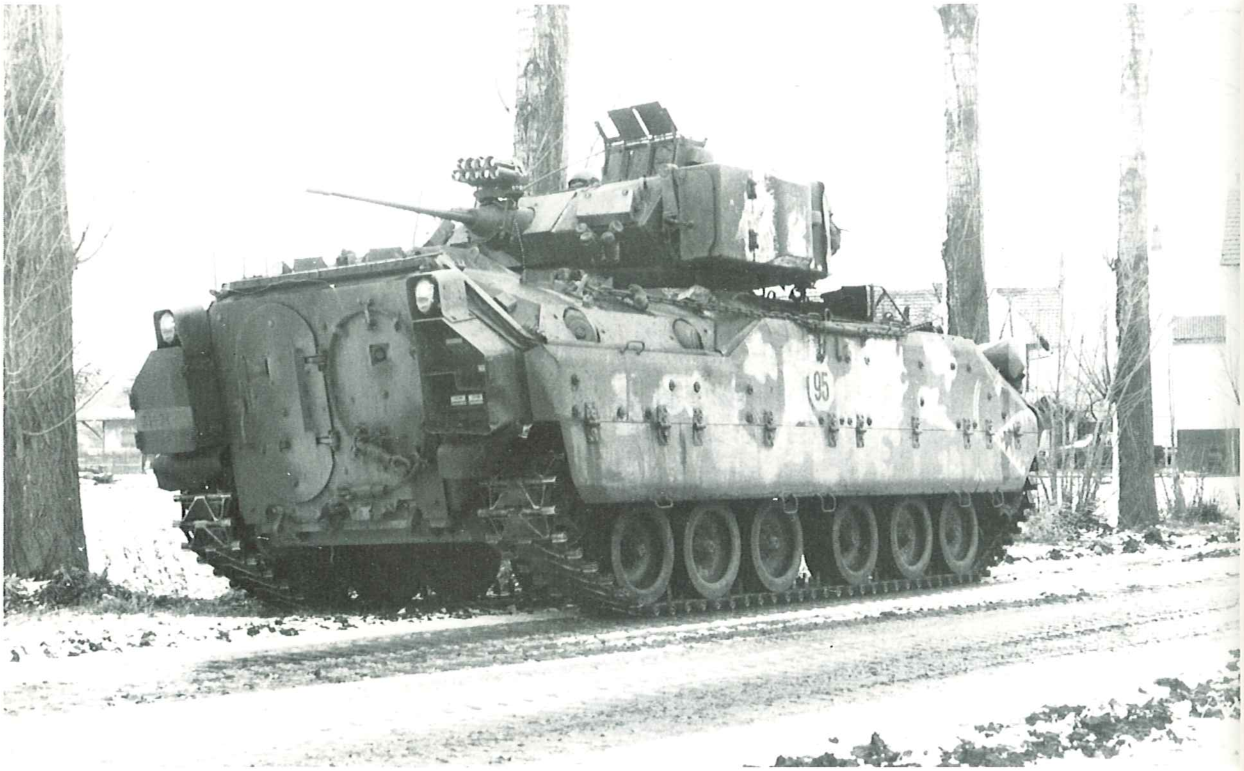
the AT-5 Spandrel missile on the BMP-2, but it is believed to be comparable in range to the TOW. The BMP-2 probably suffers in comparison to the M2 IFV in terms of weapons stabilisation, fire control and ammunition stowage. Soviet weapons stabilisation to date is markedly inferior to NATO standards, and it is not even clear if the BMP-2's gun is stabilised beyond one plane. If this is the case, it has very limited fire-on-the-move capability, increasing its vulnerability to a variety of weapons. The Soviet Army is not known to have deployed a thermal imaging night sight system even on its main battle tanks. The current Soviet capability appears to be limited to image intensification sights, which can only be used on nights when there is adequate ambient moonlight. These systems have no capability to peer through haze, dust or smoke in daylight as the Bradley's ISU can. The presence of an IR searchlight on the BMP-2 suggests that long-range night engagements would take place using this antiquated and provocative method.

An M2 of the 7th Infantry, 3rd Infantry Division (Mechanized) during the January 1985 winter 'Reforger' exercise. The vehicle is finished in a temporary snow camouflage. Above the gun tube is the usual pyrotechnic device array used during wargames to simulate firing. Note 'sharkmouth' marking, just visible at the front of the track skirt. (Pierre Touzin)

The BMP-1 was already badly cramped. The BMP-2, with its larger turret, will probably suffer even more in this respect, meaning that it cannot carry as many rounds of main gun ammunition or anti-armour missiles as the Bradley. The habitability of the BMP is very poor for any prolonged operations, the vehicle being exceedingly cramped. Although the M2 is not spacious, it is considerably better than the BMP in this respect. While this feature may seem a luxury, excessively cramped spaces add to crew fatigue and can degrade squad performance in prolonged combat actions.

The armour of the BMP-2 is probably similar to that on the BMP-1, meaning that it can be penetrated at nearly any angle by the 25 mm gun on the M2. The armour on the Bradley can probably protect it against threats greater than 14.5 mm in the frontal quadrant. Whether it is sufficient to withstand 30 mm autocannon fire at normal combat ranges is unknown.

In terms of mobility, the BMP-2 is probably fitted with a supercharged version of the 5D20 engine used in the BMP-1. The BMP-1 is a fleet vehicle on good terrain, but is notorious for flimsy construction when operated at high speeds on rough terrain. In contrast, the M2 has excellent



The remarkable robustness of the M2 is demonstrated on a test track at Aberdeen Proving Ground. This photo dramatically illustrates both the speed of the Bradley as well as its durability. A similar manoeuvre would seriously damage the flimsier Soviet BMP. (Author)

The stablemate of the M2 is the new M1 tank: seen here are an M2 Bradley and an M1 Abrams of the 3rd Infantry Division (Mechanized) during the summer 1984 'Reforger' exercise. (Defense Images Inc.)

high-speed performance in cross-country travel, and can readily withstand high-speed impacts that would crack the suspension mountings on BMPs. The M2 is considerably more robust than the BMP-2, and probably has superior cross-country performance. The BMP-2 presumably suffers the same reliability and maintainability shortcomings as most Soviet armoured vehicles. Running life is probably about 500 hours of engine use, by which time the vehicle must be rebuilt. Rebuilding probably adds another 250 hours of running time. For this reason, BMPs are restricted in their annual running time to about 250 miles in order to prolong their useful service life to about 20 years. The M2 is considerably more robust in this respect, allowing an average of 1,000 miles annual training time, with a useful life of 20–30 years depending on the amount of abuse an individual vehicle is subjected to. The M2 also incorporates current state-of-the-art simplified test equipment, and modular electronics and components design which makes fault detection and repair considerably simpler than on Soviet vehicles.

The new M2A1 and M3A1 Bradleys will be capable of firing the improved TOW-2 missile, shown here during a test firing in 1985. The extensible probe at the front of the missile gives better penetration of modern laminate armours. (Hughes Aircraft)

Comparison of the M2 with current-generation NATO vehicles such as the AMX-10 and MCV-80 is difficult due to lack of available details. In comparison with the older Marder design, the M2 is better armoured, more heavily armed, and enjoys a fully stabilised weapon system with full night vision capabilities.

Future Bradleys

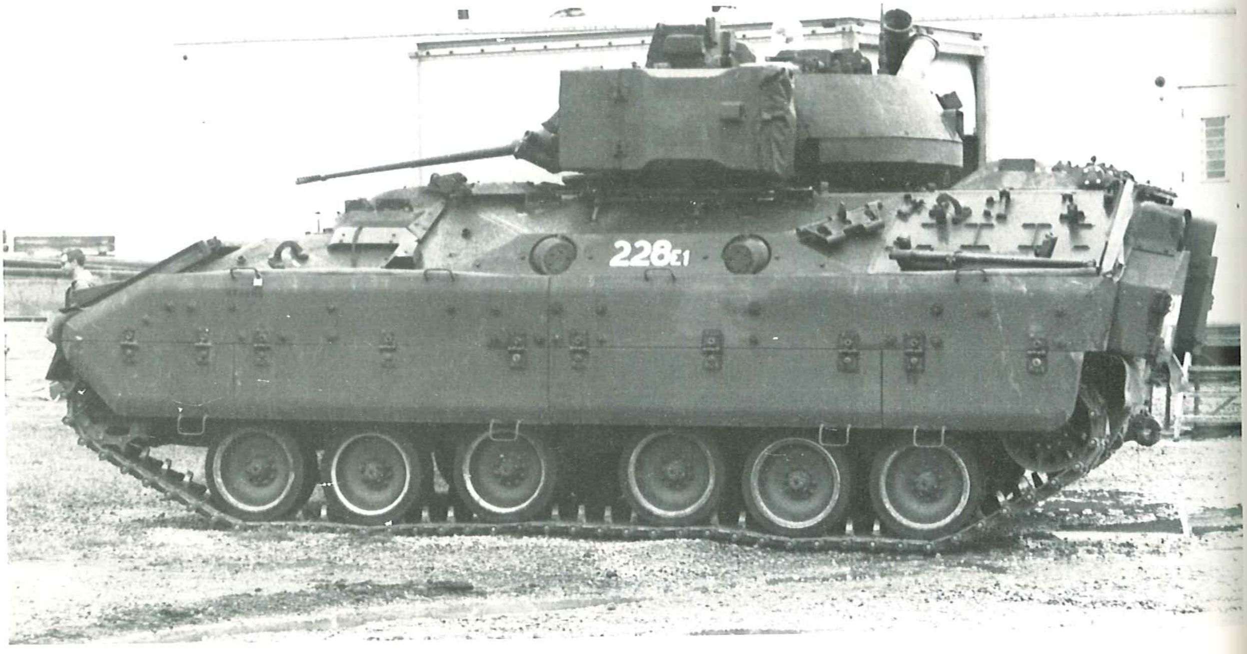
The Bradley was developed from the outset to permit modular (Block) improvements. The first series of improvements are currently being tested on the M2E1 and M3E1, which will become the M2A1 and M3A1 when accepted. The principal modification involves the chemical protection system and the TOW launcher. The current first-generation Bradley has no integral chemical defence system, and the squad must wear their suits for chemical protection. The next generation Bradley will incorporate a Gas Particulate Filter Unit (GPFU): this provides purified air to the entire vehicle crew (through their MOPP-IV gear) in the M3E1, and to the turret crew and driver in the M2E1. The other squad members in the M2E1 continue to use their own filter units. The US Army is reluctant to incorporate into the M2 a full overpressure system such as that used in the BMP: the feeling is that in chemical battlefield conditions, the system would be quickly compromised by the squad mounting and dismounting from the vehicle. The Soviet system appears to have been developed mainly for use in nuclear battlefield conditions, where the squad would remain aboard the vehicle for prolonged periods.

The other main change involves adaption of the TOW launcher to permit it to fire the TOW-2 missile with its improved warhead. The new version is believed to be capable of defeating any existing Soviet tank head-on.

There are also many other small changes in the pipeline. In the M2E1 these mainly concern internal stowage improvements. There are a number of planned external changes on the M3E1. These include removal of the vestigial closed firing ports and periscope cut-out in favour of continuous armour; a new rear hatch with periscopes to permit improved rear squad vision; and many internal stowage changes. Production of the resulting M2A1 and M3A1 Bradleys is expected to begin in May 1986.

Development work is also proceeding on Block II for the M2A2/M3A2 in the late 1980s and early 1990s. This is expected to include nuclear blast hardening, and hardening against directed energy weapons. Vision improvements are also anticipated, including a thermal imaging driver's periscope, the AN/VAS-3 DTV to replace the current AN/VSS-2 image intensification driver's night periscope. Electronic improvements to the vehicle are expected to include a vehicle navigation system, and a PLRS/JTIDS communication/navigation hybrid system. The GPFU system will probably be up-graded to incorporate optional overpressure and micro-climate cooling/heating of the crew compartment. Weapons improvements will probably include a modernised gun system with improved ammunition and possibly a lengthened gun tube. Steps are also under way to improve the fire control system to make it more suitable for engaging helicopters, in order to provide the vehicle

The prototype M3E1 during tests at Aberdeen Proving Ground. This vehicle differs from the normal M3 mainly in internal details. Note the blanked-off firing ports on the left side. (US Army APG)



SPECIFICATIONS

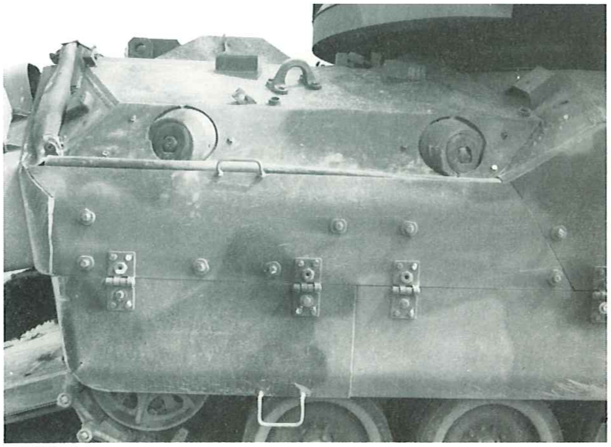
General		
Weight, combat loaded	49,138 lb	22,285 kg
Weight, less fuel, crew and OVE	41,600 lb	18,869 kg
Weight, air transportable	41,136 lb	18,656 kg
Ground pressure, combat loaded	7.7 psi	0.54 kg/cm^2
Personnel capacity, IFV	9	
CFV	5	
Fuel tank capacity	175 gallons	662 litres
Performance		
Speed on land	41 mi/h	66 km/h
Speed in water, with track	4.5 mi/h	7.2 km/h
Cruising range	300 mi	483 km
Turning radius	Pivot to infinite	
Slope	60%	
Side slope	40%	
Trench crossing	100 in.	25 m
Vertical wall climbing	36 in.	91 m
Gross horsepower-to-weight ratio	20.62 hp/ton	
Engine		
Make and model	Cummins VTA-903	
Displacement	903 in.^3	14.8 litres
Type	4 cycle	
Fuel	Diesel	
Gross horsepower	400	506 metric
Turret (Two-Man)		
Armament	25 mm cannon TOW missile launcher 7.62 mm, M240C machine gun	
Traverse	360° continuous	
Elevation		
25 mm gun and 7.62 mm machine gun	+60° to −10°	
TOW missile launcher	+30° to −20°	
Slew rate, maximum elevation and traverse	60°/sec	
Tracking rate, minimum	0.05 mil/sec	
Stabilisation system	Electric	
Ring gear, pitch diameter	60 in. (152.4 cm)	
Squad Weapons		
Firing port weapon, M231, 5.56 mm IFV only	6, ball-mounted	
Machine gun, M60, 7.62 mm	1	
Rifles, M16A1, 5.56 mm	9, IFV 5, CFV	

Ammunition	**IFV**	**CFV**
	ready/stowed	ready/stowed
25 mm	300/600	300/1200
7.62 mm	800/1540	800/3600
7.62 mm	2200 stowed	5060 stowed
5.56 mm	4200	NA
5.56 mm (M16A1)	2520 stowed	1460 stowed
TOW missiles	2 in launcher	2 in launcher
TOW Dragon missiles	5 stowed, any combination	10 TOW stowed
LAW (M72A2)	3 stowed	NA

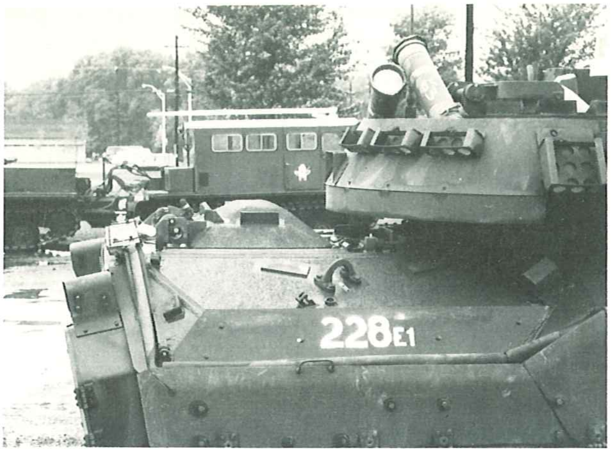
Transmission, Automatic		
Make and model	G.E. HMPT-500	
Type	Hydromechanical	
Steering	Hydrostatic	
Brake type	Multidisc, oil cooled	
Running Gear		
Suspension type	Return roller	
Springing media	Torsion bar	
Number of wheels	6 pairs per side	
Wheel Size	24 in. diam	61.0 cm
	4 in. wide	10.2 cm
Track type	Steel single pin with detachable rubber pads	
Shock absorbers	3 per side	
Number of shoes	83, left side; 82, right side	
Track pitch	6 in.	15.2 cm
Track width	21 in.	53.3 cm
Night Vision Equipment		
Sight, gunner	Thermal imagery	
Sight, commander	Optical relay from gunner's sight	
Sight, driver	AN/VVS-2	
Electrical System		
Generator		
Amperes	220	
Volts, dc	28	
Batteries	4, type 6TN, 100 amp-hr, 12-volt each	
Communications (Commander Vehicle)		
Radio, IFV	AN/VRC-46, 1 set AN/GRC-160, 1 set	
Radio, CFV	AN/VRC-12, 1 set AN/PRC-77, 1 set	
Armour		
Top and front slopes	5083 aluminium	
Vertical sides and rear	Spaced laminate armour	
Bottom	5083 aluminium with antimine appliqué (IFV only)	
Side slopes	7039 aluminium	
Fire Extinguisher		
Fixed	7 lb (3.2 kg) Halon in engine compartment 2 × 5 lb (2.3 kg) Halon in personnel compartment	
Portable	2.75 lb (1.2 kg) Halon	

with some measure of anti-helicopter self-defence capability.

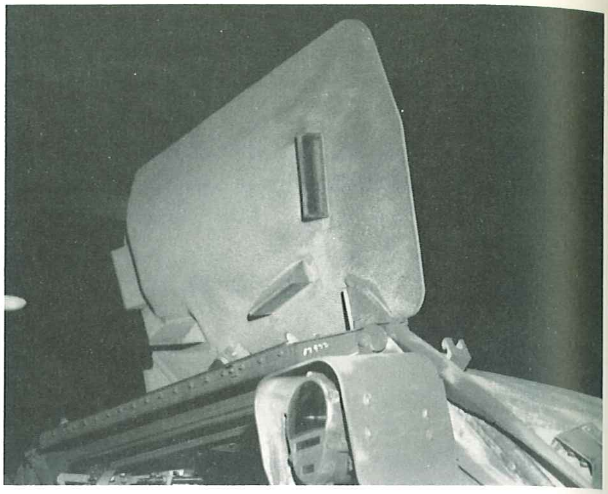
There have been a number of attempts to develop even more elaborate derivatives of the Bradley. Some aspects of these are known, but others are shrouded in secrecy. The CVAST was developed in the early 1980s as a potential response to the advent of the BMP-2 and a follow-on to the BMP. This consists of a new turret/armament package developed by FMC and Ares Inc. built



In contrast to the blanked-off firing ports on the M3, the M2 and M2E1 are fitted with operational firing ports, seen here with the FPW fitted. (US Army APG)



This view of the M3E1 prototype shows some of the external changes being introduced on this version, including the new rear hatch with vision blocks, and the faired-over firing ports. (US Army APG)



A detailed view of the new rear hatch being developed for the M3A1 Bradley.

around a 35 mm gun. This programme aimed at extending the effective range and penetration power of the Bradley weapon. It would now appear that ammunition and gun improvements will give the Bradley sufficient capability without resort to a major modification of this sort. Nevertheless, the programme continues to be pursued in the event of a future requirement.

At a more exotic level, the M2 served as the testbed platform of a laser assault weapon, known by the code-name 'Roadrunner'. This was supposed to progress into an actual combat laser system sometimes called CCLAW (Close-Combat Laser Assault Weapon). The programme was aimed at developing a vehicle-mounted, medium-energy laser weapon capable of crazing the optics and vision ports on opposing tactical vehicles, the destruction of electro-optical sensors, and the 'opaqueing' of helicopter or jet aircraft canopies. In 1984 the Army publicly announced that it was cancelling the programme on budgetary grounds, following some Press discussion of the programme. The Press reports had criticised the programme on the grounds of suspicion that the actual intent was to develop a new battlefield system that could blind enemy troops. The Army is known to be pursuing a number of medium-energy laser weapon programmes, though their relation to the M2 programme is completely unknown.

Far less futuristic are the XM4 Armored Gun System and the ETAS programme. The XM4 AGS is an attempt to develop a light tank armed with a 105 mm gun using the M2 Bradley chassis. The programme has been dragging on for years under a confusing cloud of acronyms such as MPGS (Mobile Protected Gun System), APAS, AMAS, etc. Although the Army-sponsored programme may fade into oblivion due to bureaucratic dry-rot, commercial development of such a system for export is not unlikely. ETAS (Elevated Target Acquisition System) is an attempt to develop a sensor pod, mounted on the end of a telescoping pole assembly. The rationale behind this is that by fitting such a sensor to the M3 CFV scout vehicle, the M3 could hide behind terrain, protecting itself from counterfire, while the sensor package is elevated high above for a better view of the surroundings. Such a pod would probably contain a thermal viewer, a low-probability-of-intercept radar, a laser range finder and a radio frequency interferometer.

The Basic Bradley chassis also forms the basis for the M987 Fighting Vehicle System armoured transporter. This is currently used as the basis of the MLRS multiple rocket launcher vehicle. A number of other derivatives have also been developed, including the XM1007 AFARV tank re-ammunition vehicle, and a Firefinder mobile radar vehicle using a Hughes phased-array surveillance radar.

Although the Bradley has not yet been exported, several countries have examined it for possible purchase. Britain considered licence production, but opted to develop the MCV-80 instead due to pressure from British industry. The M2 was demonstrated in Saudi Arabia, but purchase of the Bradley there is complicated by political resistance in the US Senate, which tends to be pro-Israeli. The basic FVS chassis will be built in Europe as part of the NATO MLRS programme.

The M2 Bradley IFV is only one more step in the development of modern infantry tactics. Its rôle in contemporary operations should also be seen in the larger context of airmobile infantry tactics. If anti-armour weapons continue to proliferate on the battlefield, and if their lethality continues to rise, IFVs may become increasingly unviable. Whether they are replaced by heavy infantry vehicles for ground assault tactics, supplemented by infantry helicopters for high-speed mobile operations, remains to be seen. We may hope that the 40 years of tranquillity on the Central Front continues, and that the wretchedly tough business of mechanised infantry fighting can slip into oblivion.

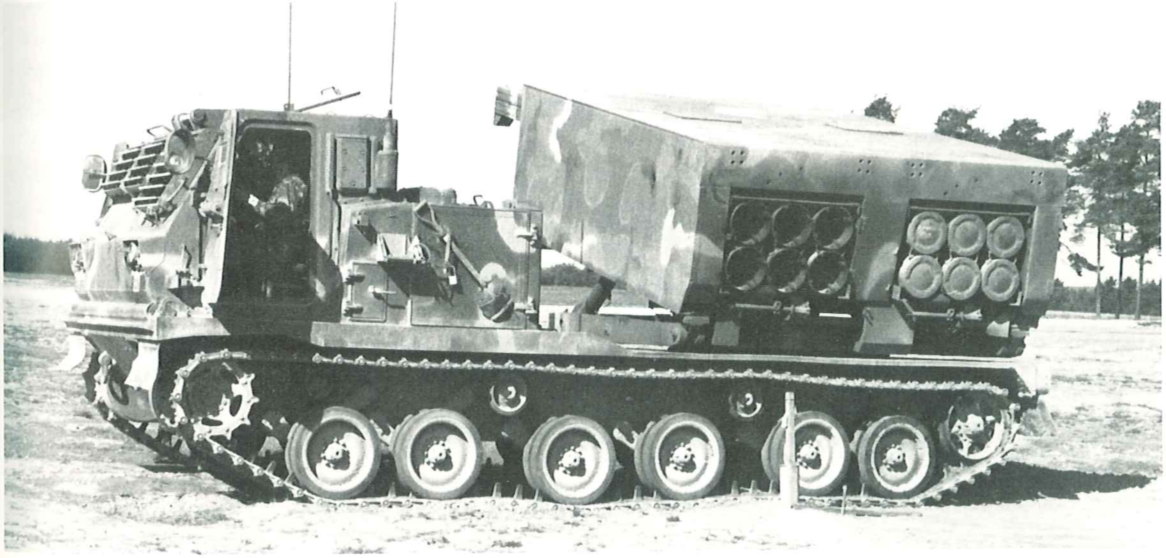
The Plates

A1: M2 IFV, 1–41st Infantry, 2nd Armored Division; Fort Hood, Texas, 1984

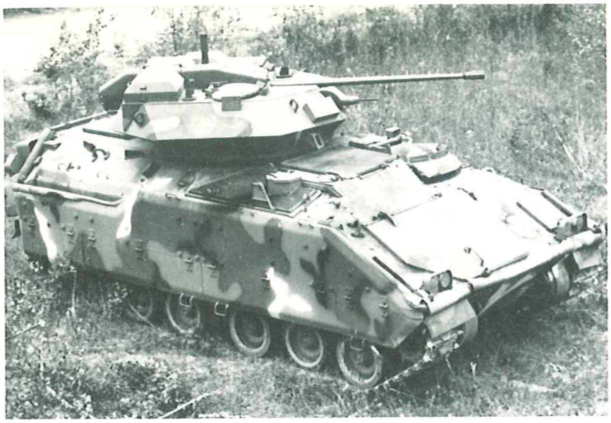
The Bradleys of the 2nd Armored Division are almost universally finished in the four-colour MERDC scheme of Forest Green (FS34079) and Field Drab (FS30118) with Sand (FS30277) and Black blotches. The division's vehicles usually carry a black triangle—as shown here—to distinguish them from the vehicles of the neighbouring 1st Cavalry Division, also stationed at Fort Hood. This Bradley has the traditional style of US bumper codes. The black bumper codes were selected for low visibility and have worked too well—they are very difficult to read when painted over dark camouflage colours. As a result, many units now paint them over a Sand-coloured patch: here, '2△/I-1-41' and 'C26'. This vehicle has the turret crew's names painted on the front turret smoke grenade boxes: 'LT/JOZWIAK' and 'SGT/BILSBY'.

A2: M2 IFV, 2–41st Infantry, 2nd Armored Division; Fort Hood, Texas, 1985

In 1984 the 2nd Armored Division began adopting a new style of battalion and company insignia to make it easier to identify units during field operations. This insignia is supposed to be painted on the rear of the troop hatch of Bradleys, and on the commander's hatch: the latter is less common than the former. The colour of the outer geometric shape identifies the regiment; in this case it is light blue for the 41st Infantry (and red for the 1st Cavalry). The shape of the outer geometric design indicates the battalion: diamond (1st Bn.), square



The M270 MLRS artillery rocket system is based on the M987 armoured transporter. This is a derivative of the basic Bradley chassis. (Pierre Touzin)



The CVAST was developed by FMC Corp. and Ares Inc. in response to the appearance of the Soviet BMP-2 with its long-range 30 mm autocannon. Although there are no plans to begin building this version, which mounts a 35 mm cannon, it is being developed as a standby in the event of future Soviet developments in this field. (US Army)

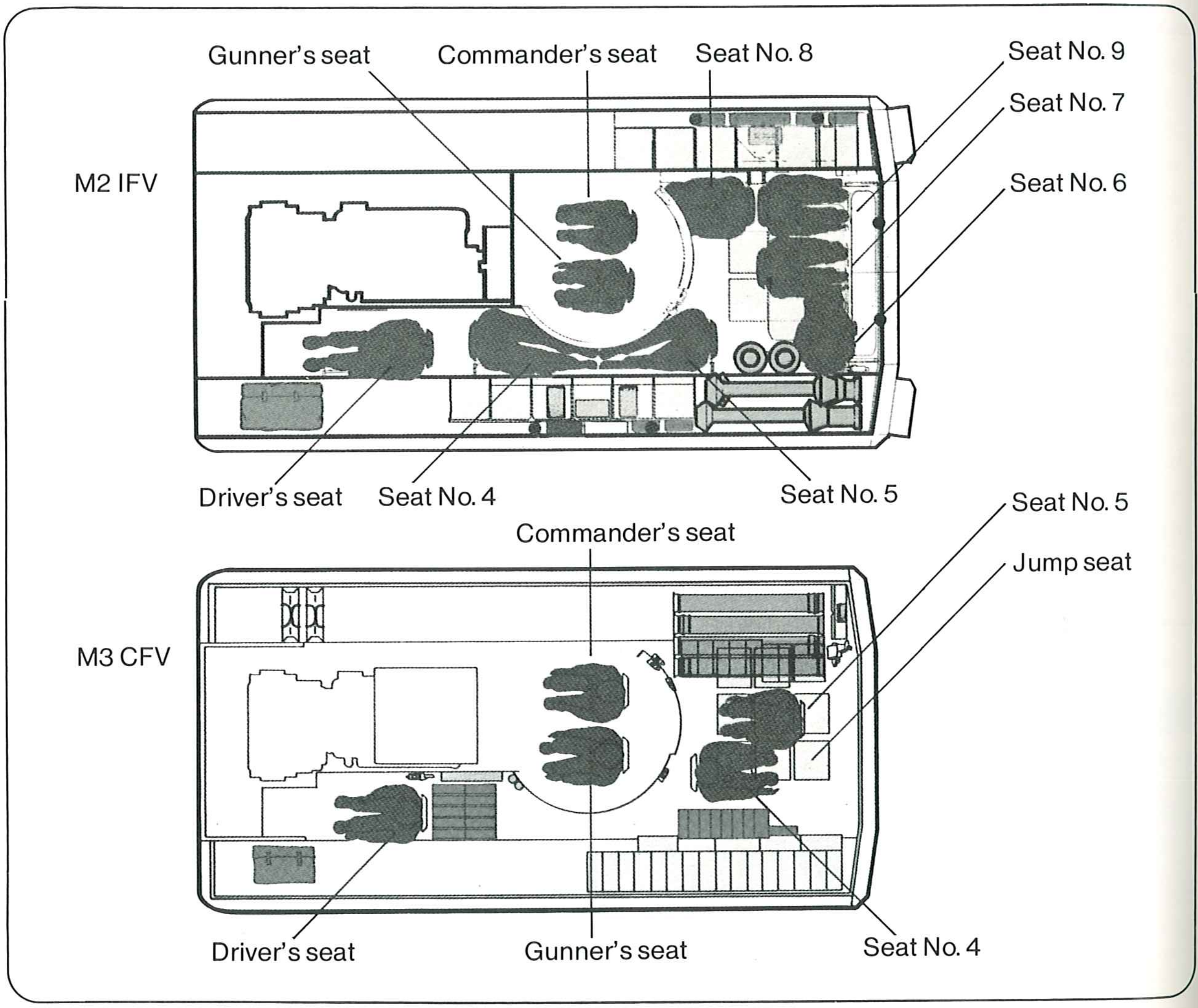
A comparison of the interior of the M2 IFV and M3 CFV. (FMC Corp.)

(2nd Bn.), circle (3rd Bn.) and pentagon (4th Bn.). The inner black geometric shape identifies the company: diamond (A Co.), square (B Co.), circle (C Co.), pentagon (D Co.) and triangle (E Co.). (A related set of markings is shown in Vanguard 41, *The M1 Abrams Battle Tank.*) Bumper codes here are '2-△-2-I-41' and 'A33.'

Patch details are: *(3)* 1st Ptn., B Co., 1-41 Inf.; *(4)* 2nd Ptn., C Co., 2-41 Inf.; *(5)* 3rd Ptn., D Co., 3-41 Inf.; *(6)* 1st Ptn., E Co., 4-41 Inf.; *(7)* 2nd Ptn., C Co., 2-1 Cavalry.

B1: M2 IFV, 1–7th Infantry, 3rd Infantry Division; 'Reforger' Exercise, Federal Republic of Germany, September 1984

The Bradleys stationed in Europe are almost uniformly left in their original factory scheme of overall Forest Green. During summer 'Reforger'


Gunner's seat
Commander's seat
Seat No. 8
Seat No. 9
Seat No. 7
M2 IFV
Seat No. 6
Driver's seat
Seat No. 4
Seat No. 5
Commander's seat
Seat No. 5
Jump seat
M3 CFV
Driver's seat
Gunner's seat
Seat No. 4

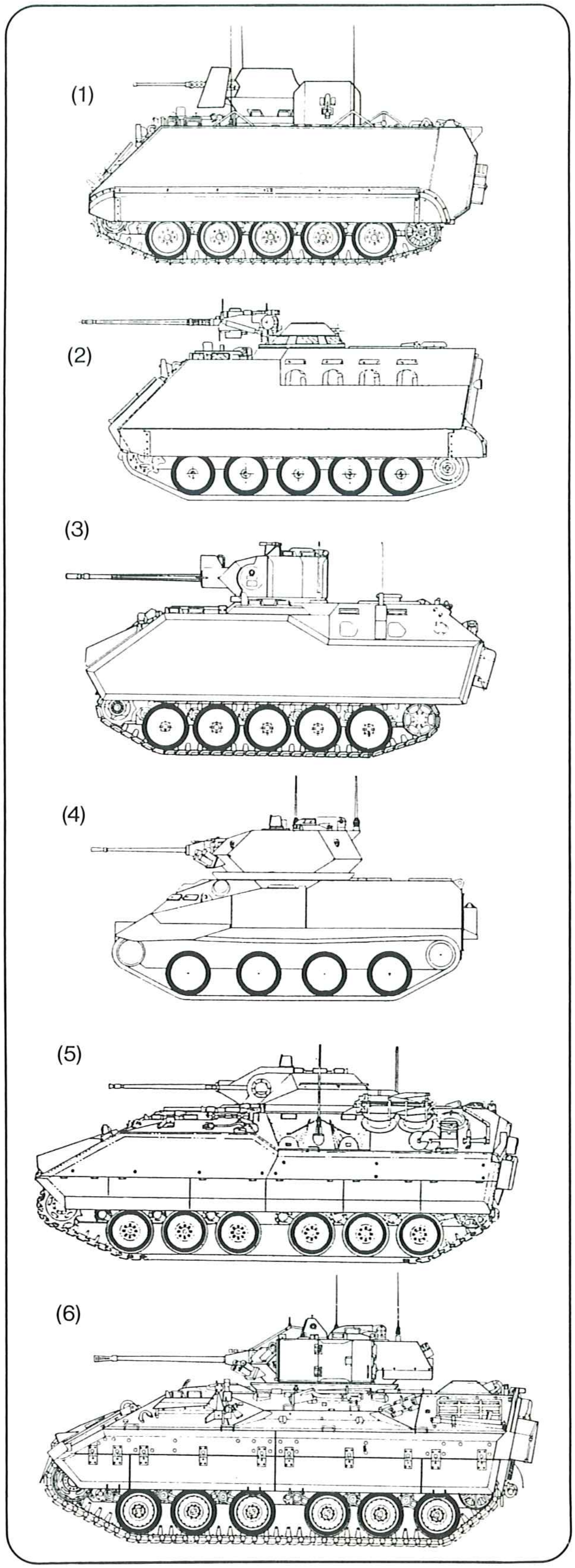
exercises the various NATO units are divided into 'Orange' and 'Blue' armies to wage mock battles. During the 1984 exercise the 1–7th and 1–15th Infantry served with the Orange army, hence the orange temporary markings taped on this vehicle. The 3rd Infantry Division also uses a set of rear turret insignia to distinguish its battalions. In the case of 1–7th Infantry, this consists of a white hexagon which identifies the battalion, with inner geometric shapes to identify the companies: an upwards triangle (A Co.), a square (B Co.), a circle (C Co.) and a downward triangle (D Co.). The vertical bars indicate the platoon. As mentioned earlier, the unit bumper codes are usually painted on a Sand-coloured patch, in this case covering the whole transmission housing: '3-I/1-7-I' and 'A/34'.

B2: M2 IFV, 1–15th Infantry, 3rd Infantry Division; 'Reforger' Exercise, Federal Republic of Germany, September 1984

This vehicle is marked in a similar fashion to the vehicle above, but with changes for unit identification. The 1–15th Infantry uses an octagon as its battalion insignia, and the inner designs follow the same pattern as the 1–7th Infantry. The rear bumper codes are painted over the rear stowage bins, the covers of which are painted overall Sand: '3-I-15I' and 'A-12'.

C1: M2 IFV, 7th Infantry, 3rd Infantry Division; 'Reforger' Exercise, Federal Republic of Germany, January 1985

The 1985 'Reforger' exercise was held in the winter instead of the summer, resulting in the use of some improvised snow camouflage on many vehicles. This M2 is finished very similarly to those shown on Plate B, but with the obvious addition of extemporised snow camouflage. One minor change in marking detail was the addition of the vehicle crew names on the driver's hatch and turret, on Sand rectangles. Bumper codes are '3-I/1-7-I' and 'A/23'. (This plate and Plate B were researched with the assistance of Arnold Meissner.)



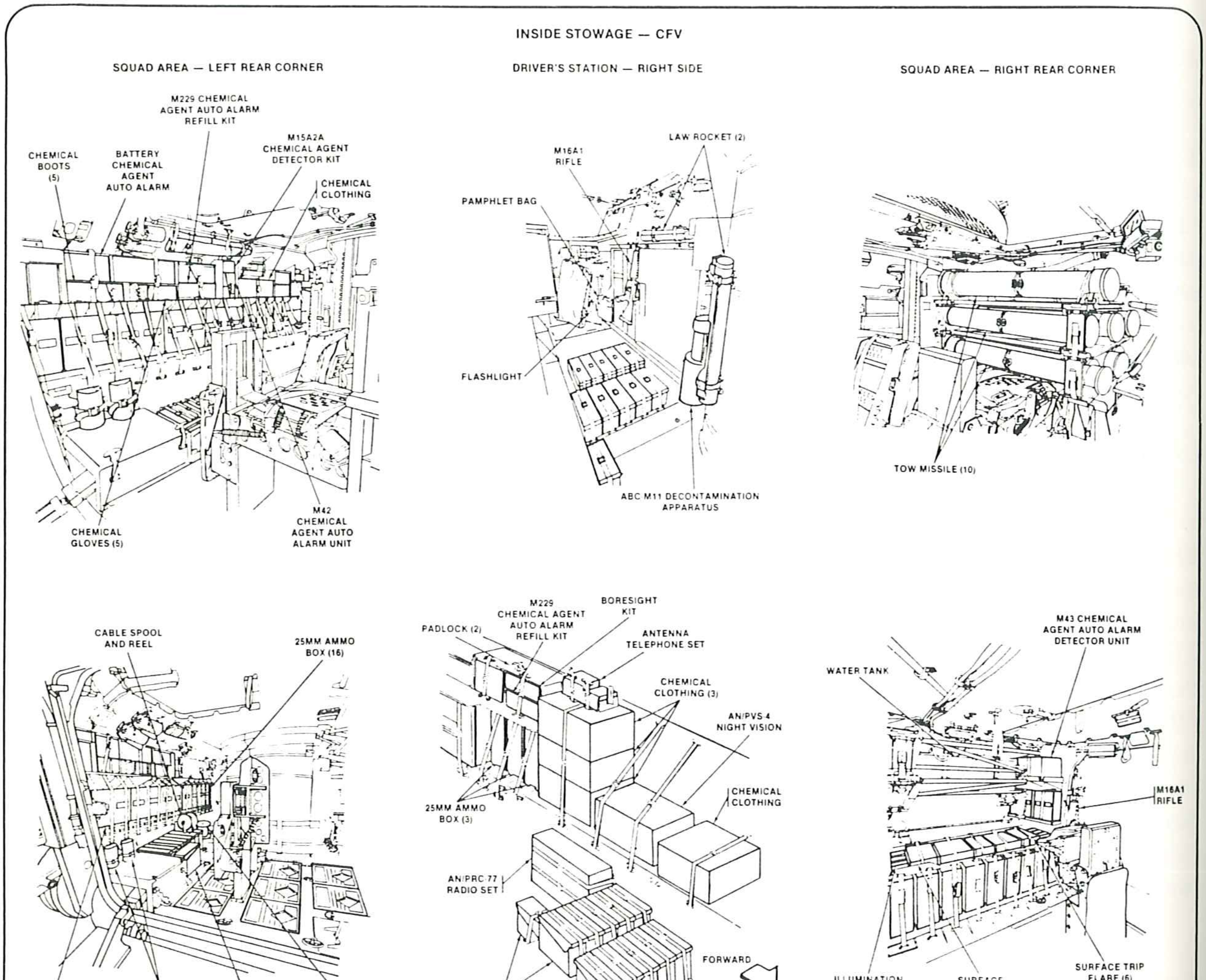
The evolutionary tree of the Bradley: (1) M113 ACAV; (2) Product Improved M113 (XM765); (3) YPR-765 AIFV; (4) XM800-T ARSV; (5) XM723 MICV; (6) M2 IFV.

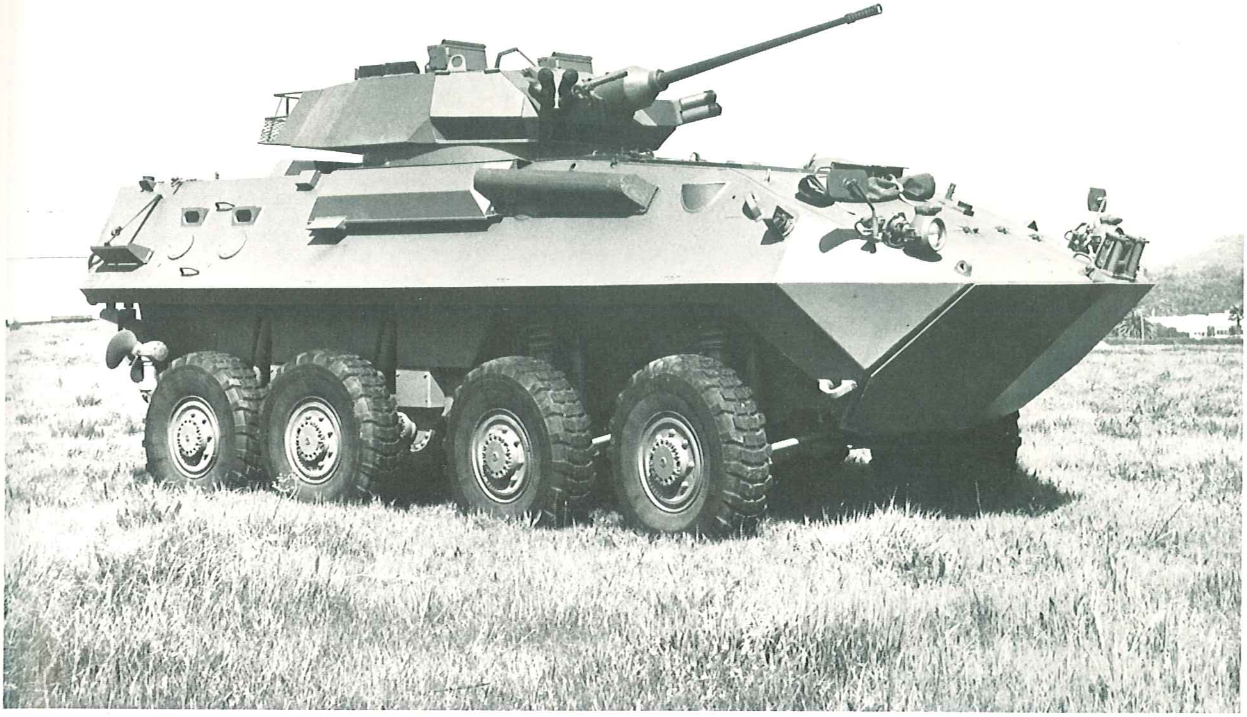
C2: M2 IFV, US Army Cold Regions Test Center; Fort Greely, Alaska, 1984

One of the early-production Bradleys was shipped to Fort Greely for arctic weather trials, and finished in a four-colour MERDC pattern of Forest Green, White, Sand and Black. It carries the number '11' in white on the bow plate, both hull sides, and the left rear stowage box cover. On the swim vane is the name DANGEROUS DAN in red, with the Army Material Command and Army Cold Regions Test Center emblems on either side. As a final touch a fantasy character, derived from Frank Frazetta's painting *The Silver Warrior*, has been added on the bow above the swim vane. (This plate was researched by Bob Lessels.)

D: M2 Bradley, Inter-NATO Three-Colour Camouflage Scheme, 1985

In 1983 the Bundeswehr began pressuring other NATO armies to adopt a new, standardised three-colour camouflage. The primary reason was the realisation that the nationality of NATO vehicles could readily be recognised from the varying styles of camouflage painted on armoured vehicles of the different NATO armies. The US Army agreed to go along with this decision, since it was planning to adopt a new camouflage system anyway. The older MERDC system, although in many ways more sophisticated and effective than the German patterns, was very complicated. It was supposed to be applied by units in the field, and changed to


INSIDE STOWAGE — CFV
SQUAD AREA — LEFT REAR CORNER
M229 CHEMICAL AGENT AUTO ALARM REFILL KIT
M15A2A CHEMICAL AGENT DETECTOR KIT
CHEMICAL BOOTS (5)
BATTERY CHEMICAL AGENT AUTO ALARM
CHEMICAL CLOTHING
CHEMICAL GLOVES (5)
M42 CHEMICAL AGENT AUTO ALARM UNIT
DRIVER'S STATION — RIGHT SIDE
LAW ROCKET (2)
M16A1 RIFLE
PAMPHLET BAG
FLASHLIGHT
ABC M11 DECONTAMINATION APPARATUS
SQUAD AREA — RIGHT REAR CORNER
TOW MISSILE (10)
CABLE SPOOL AND REEL
25MM AMMO BOX (16)
25MM AMMO BOX (5)
CLAYMORE MINE (2)
7.62MM AMMO BOX (9)
CABLE SPOOL (PLATOON LEADER ONLY)
SQUAD AREA — LEFT REAR CORNER (cont)
M229 CHEMICAL AGENT AUTO ALARM REFILL KIT
BORESIGHT KIT
PADLOCK (2)
ANTENNA TELEPHONE SET
CHEMICAL CLOTHING (3)
AN/PVS 4 NIGHT VISION
CHEMICAL CLOTHING
25MM AMMO BOX (3)
AN/PRC 77 RADIO SET
7.62MM AMMO BOX (11)
FORWARD
SPONSON — LEFT CENTER
M43 CHEMICAL AGENT AUTO ALARM DETECTOR UNIT
WATER TANK
M16A1 RIFLE
ILLUMINATION SIGNAL (8)
SURFACE TRIP FLARE (4)
SURFACE TRIP FLARE (6)
SQUAD AREA — RIGHT REAR CORNER (cont)



The M1047 LAV-25 is the US Marine equivalent of the M2 Bradley IFV. The Army considered adopting this vehicle for its light divisions in lieu of the Bradley, but this idea was squashed both by a lack of Army enthusiasm for the vehicle and by Congressional refusal to fund Army acquisition. (GM-Canada)

match climatic changes. Its complexity frustrated many field units, and the idea of altering the paint finish seasonally never caught on. Secondly, the MERDC scheme was applied with a type of paint unsuitable for chemical decontamination. When the US adopts the new three-colour scheme, it will be factory-applied in a new semi-gloss paint which is easier to decontaminate. It is not clear if the US Army will adopt colour patterns other than this Forest Green, Black and Field Drab version, more suitable for prairie, desert or winter conditions.

E, F, G: M2 and M3 interior views:

E1: Overall view, M2 interior, looking forward from rear ramp

E2: Overall view, M3 interior, looking forward from rear ramp

F1: M2 IFV, right side

F2: M3 CFV, right side

G1: M2 IFV, left side

G2: M3 CFV, left side

Note that these photographs show vehicles without full interior stowage, which is illustrated in the accompanying monochrome photographs and stowage diagrams. Note also the inevitable perspective distortion caused by the lens necessary for these very short-range views.

H: US Mechanised Infantry Uniforms, 1986

This plate shows the newer pattern of uniforms and equipment being adopted by the mechanised infantry in the 1980s. Plate H1 is a vehicle crewman, and is seen wearing the DH132 CVC (Combat Vehicle Crew) helmet. He is wearing the standard Woodland pattern battledress, and is armed with the M231 Firing Port Weapon (FPW). The FPW is designed for use from the Bradley firing ports, and the infantry squad on board each have a normal M16A2 as well as an FPW. Plate H2 is the squad gunner, equipped with an M249 SAW (Squad Automatic Weapon), a US version of the Belgian FN Minimi light machine gun. He is wearing the normal Woodland pattern battledress, a PASGT vest and the Alice equipment. Plate H3 is a rifleman, armed with the M16A2 assault rifle and fitted out in a similar fashion to the gunner. Note that these figures wear the experimental no-polish combat boots. These were issued to select units for a short time in 1983–84, but were withdrawn due to unacceptably short life. A modified version is expected to replace the traditional gloss black leather combat boot in the next few years.

Notes sur les planches en couleur

A1 Finition de peinture dans les quatres couleurs *MERDC*; le triangle noir est l'insigne de la division; numéros de code de l'unité de l'armée américaine standard peints sur les garde-boues; noms de l'équipage peints sur la tourelle. **A2** Nouveaux insignes 1984 de l'unité: bleu clair pour le 41e régiment, forme carrée pour le 2e régiment; signe intérieur noir dénotant la compagnie, par forme—A = losange, B = carré, C = disque, D = pentagone, E = triangle.

B1 Finition de peinture totalement verte appliquée en usine; les insignes temporaires oranges indiquent Armée 'Orange' en manoeuvre '*Reforger*'; l'héxagone blanc permet d'identifier le bataillon et les formes intérieures les compagnies—A = triangle à pointe en haut; B = carré, C = disque, D = triangle à pointe en bas. Les barres verticales permettent d'identifier le peloton. **B2** Finition de peinture similaire à celle du véhicule ci-dessus mais avec des insignes octagonaux permettant d'identifier le ler Bataillon, 15e infanterie.

C1 Camouflage temporaire de neige sur finition de peinture verte. **C2** Pour les épreuvres arctiques, peinture de camouflage en vert, sable, noir et blanc. Les insignes sont celles de la *US Army Material Command* et de l'*Army Cold Region Research Center*; le nom '*Dangerous Dan*' et le dessin de *Frank Frazetta* sont ajoutés par l'équipage. Le numéro '11' est peint à l'avant, des deux côtés et sur la boîte de rangement de coque arrière gauche.

D1, D2 Nouvelle finition 1985 en trois couleurs, qui sera adoptée pour tous les véhicules blindés de l'OTAN pour raisons de sécurité, afin que la nationalité ne puisse plus être reconnue d'après les finitions de camouflage.

E1 M2, intérieur, en regardant vers l'avant. **E2** M3, intérieur, en regardant vers l'avant.

F1 M2, intérieur, côté droit. **F2** M3, intérieur, côté droit.

G1 M2, intérieur, côté gauche. **G2** M3, intérieur, côté gauche.

H1 Homme d'équipage du Bradley portant le casque DH132, la tenue de combat de modèle 'forêt' et tenant le *Firing Port Weapon* M231—fusil M16 modifié pour emploi à partir des orifices de tir du Bradley. **H2** Mitrailleur de l'escadron portant la tenue de combat 'forêt', le casque Kevlar ('Fritz'), l'équipement *ALICE* et portant la mitraillette légère M249 SAW. **H3** Fusilier d'un escadron d'infanterie mécanisée, portant la même tenue de base que H2. Les bottes expérimentales brunes portées par tous ces hommes furent supprimées après une brève distribution en 1983–84.

Farbtafeln

A1 Vierfarbiges *MERDC* Farbenschema; schwarzes Dreieck als Dividionsabzeichen; übliche US Army Einheit Codenummern auf den Kotflügeln aufgemalt; Namen der Besatzung auf der Kanzel. **A2** Neue Einheitsmarkierungen von 1984; hellblau identifiziert das 41st Regiment, das Viereck steht für das 2nd Bataillon, das innere schwarze Abzeichen für die Kompanie, je nach Form—A = Karo, B = Viereck, C = Scheibe, D = Fünfeck, E = Dreieck.

B1 Grünes Farbschema, in der Fabrik aufgetragen; vorübergehende orangefarbene Markierungen bezeichnen die 'Orange' Army bei der Übung '*Reforger*'; das weisse Sechseck bezeichnet das Bataillon und das innere Abzeichen die Kompanien—A = aufwärts zeigendes Dreieck, B = Viereck, C = Scheibe, D = abwärts zeigendes Dreieck. Die senkrechten Streifen identifizieren den Zug. **B2** Ähnliches Schema wie bei dem obigen Fahrzeug, aber mit achteckigem Abzeichen für das 1st Bn., 15th Infantry.

C1 Vorübergehende Schneekamouflage über dem grünen Farbschema. **C2** Für arktische Versuche ist die Kamouflage in grün, sandfarben, schwarz und weiss. Die Abzeichen gehören zum *US Army Material Command* und dem *Army Cold Region Test Center*; der Name '*Dangerous Dan*' und die *Frank Frazetta* Figur stammen von der Besatzung. Die Nummer 11 ist auf der Vorderseite an beiden Seiten aufgemalt, hinten links der Ladekasten.

D1, D2 Neues Farbschema von 1985, das aus Sicherheitsgründen bei allen Panzerfahrzeugen der NATO eingeführt werden soll, damit die Nationalität sich nicht länger anhand der Kamouflage feststellen lässt.

E1 M2, Inneres, von hinten gesehen. **E2** M3, Inneres, von hinten gesehen.

F1 M2, Inneres, rechte Seite. **F2** M3, Inneres, rechte Seite.

G1 M2, Inneres, linke Seite. **G2** M3, Inneres, linke Seite.

H1 Bradley Besatzungsmitglied mit DH132 Helm, Kampfanzug mit 'Woodland' Muster und M231 *Firing Port Weapon*—ein modifiziertes M16 für die Bradley Schiesscharten. **H2** MG-Gruppenschütze mit 'Woodland' Kampfanzug, Kevlar Helm ('Fritz'), *ALICE* Ausrüstung und einem leichten M249 SAW MG. **H3** Gewehrschütze einer Panzerinfanteriegruppe mit der gleichen Grundausrüstung wie in H2. Die experimentellen braunen Stiefel aller dieser Männer wurden nach einer kurzen Periode 1983/84 zurückgezogen.

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A series of books describing key units and weapons systems of 20th century warfare, prepared by leading military experts for the enthusiast and modeller, and illustrating authentic details of armour and supporting vehicles, camouflage, markings, uniforms, insignia and weapons.

Avec annotations en francais sur les planches en couleur

Mit Aufzeichnungen auf deutsch uber die Farbtafeln

(3) US 1st Infantry Division 1939–45
(6) The Lee/Grant Tanks in British Service
(8) US 1st Marine Division 1941–45
(13) The Churchill Tank
(15) The Sherman Tank in British Service 1942–45
(16) The Panzerkampfwagen III
(17) The Stuart Light Tank Series
(18) The Panzerkampfwagen IV
(19) Armour of the Middle East Wars 1948–78
(20) The Tiger Tanks
(21) The PzKpfw V Panther
(22) The Centurion Tank in Battle
(23) British Tanks in N. Africa 1940–42
(24) Soviet Heavy Tanks
(25) German Armoured Cars and Recce Half-Tracks 1939–45
(26) The Sherman Tank in US and Allied Service
(27) Armour of the Korean War 1950–53
(28) The 6th Panzer Division 1937–45
(29) The M47 & M48 Patton Tanks
(30) Polish Armour 1939–45
(31) US Half-Tracks of World War II
(32) The SdKfz 251 Half-Track
(33) German Light Panzers 1932–42
(34) M113 Series
(35) Armour of the Pacific War
(36) Long Range Desert Group
(37) Modern Soviet Combat Tanks
(38) Mechanised Infantry
(39) US Armour Camouflage and Markings 1917–45
(40) US Light Tanks 1944–84; M24 Chaffee, M41 Walker Bulldog and M551 Sheridan
(41) The M1 Abrams Battle Tank
(42) Armour of the Vietnam Wars
(43) The M2 Bradley Infantry Fighting Vehicle
(44) Anti-Tank Helicopters
(45) Amtracs: US Amphibious Assault Vehicles
(46) The Renault FT Light Tank

STEVEN J. ZALOGA was born in 1952, received his BA in history from Union College, and his MA from Columbia University. He has published over twenty books and numerous articles dealing with modern military technology, especially armoured vehicle development. His main area of interest is military affairs in the Soviet Union and Eastern Europe in the Second World War, and he has written as well on American armoured forces. Steven Zaloga lives in Connecticut.

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